IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF TRANSLATION

Honourable Commissioner of
Patents and Trademarks
Washington, D.C. 20231

Sir:

I, Laurence Christopher McDonald, B.A, Technical Translator, of c/o Priory Translations Limited, 11, Magdalen Street, Colchester, Essex, England, hereby state:

THAT I am well acquainted with the German and English languages.

THAT I translated the document identified as US Provisional Application with amendments No. 60/430,564

THAT the attached English translation is a true and correct translation of US Provisional Application with amendments No. 60/430,564 to the best of my knowledge and belief; and

THAT all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true and further, that these statements are made with the knowledge that wilful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code

LAURENCE CHRISTOPHER MCDONALD

Apparatus for the dispensing of liquids, container cartridge suitabl for this, and system comprising the apparatus for the dispensing of liquids and th contain r cartridge

The present invention relates to a propellant-gas-free apparatus for the dispensing of liquids, a container cartridge suitable for this for storing the liquid and the ensemble comprising both. The invention also comprises

a) a device for the exertion of pressure on a reservoir (container cartridge), which has means for accommodating the reservoir and

b) the reservoir itself, whereby a dispensing facility, e.g. a nozzle and/or nozzle facility, is integrated into this.

The apparatus according to the invention can be used e.g. as a needleless injector or as an atomizer. In the last case it serves to provide an aerosol of droplets for inhalative intake through the mouth and throat area into the lung of a patient or for nasal intake. The atomizer according to the invention can also be used for eye treatment with the help of a supplementary adapter.

Within the framework of the present invention the apparatus is also called device, needleless injector, atomizer or else dosing inhalation device. The terms are used as equivalents. Depending on the context, either only the device for the exertion of pressure or the ensemble of same with the container cartridge is meant. The difference between the atomizer according to the invention and the needleless injector consists in functional terms mainly in the configuration of the dispensing facility: in the case of the needless injector this is so designed that a liquid jet emerges from it which remains as such. In the case of the atomizer the dispensing facility is so designed that either an aerosol emerges from it and/or at least two liquid jets meeting each other, which are atomized into an aerosol by the reciprocal impact.

State of the art

The nebulizer preferably serves as an inhaler for liquid pharmaceutical active ingredient formulations. The latter are preferably propellant-gas-free and the pharmacologically active constituents are preferably dissolved or suspended in water, in water-ethanol mixtures or in other pharmacologically compatible non-volatile liquids. The formulations are preferably solutions based on water and/or water-ethanol.

Such formulations lead in the case of inhalative application to an optimal active ingredient distribution of the active substances in the lung when they are converted, by mean of inhalers suitable for this, into lung-accessible aerosols. Such a device for the propellant-gas-free administration of a dosed quantity of a liquid drug for inhalative application is described in detail for example in the international patent application WO 91/14468 "Atomizing Device and Methods" or also in WO 97/12687. Reference is hereby made expressly to the said references and the technology described there is called "Respimat® technology" within the framework of the present invention. This term also includes in particular the technology on which a device according to Figures 6a and 6b of WO 97/12687 and the associated description is based in principle, in particular the technology for the exertion of pressure, the locking clamping means and the means for the dispensing of the liquid. These inhalers can atomize a small quantity of a liquid formulation in the therapeutically necessary dosage into a therapeutically-inhalatively suitable aerosol within a few seconds. These nebulizers can already nebulize a quantity of less than 100 microlitres of active ingredient solution with preferably one stroke to an aerosol with an average particle size of less than 20 micrometres so that the inhalable portion of the aerosol already corresponds to the therapeutically effective quantity.
In these nebulizers with Respimat® technology a drug solution is converted by means of high pressure of up to 500/600 bar into a lung-accessible aerosol and sprayed. In these inhalers the solution formulations are stored in a reservoir. From there they are conveyed via a riser tube into a pressure chamber and further nebulized via a nozzle. It is necessary that the active ingredient formulations used display an adequate storage stability and at the same time their state is such that they can be applied directly if at all possible without further manipulation according to the medicinal purpose. Furthermore, they must not contain constituents which can interact with the inhaler so that the inhaler or the pharmaceutical quality of the solution, respectively of the produced aerosol, could be damaged.

WO 01/64268 describes a needleless injector which operates with a pressure-exertion means similar to the device of WO 97/12687.

EP 0918570 describes an atomizer for nose sprays which contains, as core elements, a spring-operated piston and a nozzle facility. Between piston and nozzle a container can be inserted which has a plunger on the bottom side and is closed top-side via a seal. This seal of the container is opened before first use by moving the external nozzle, integrated in the atomizer, through the seal.

The described nebulizers are intended primarily for continuous use, i.e. for a use without lengthy breaks. In the case of a lengthy time break the part of the solvent of the liquid active ingredient formulation that is located outside the reservoir in only small volumes in the pumping- and/or pressure- and/or spray mechanism can evaporate and lead there to a formulation with a concentrated quantity of active ingredient or the formulation dries up. In these cases the device must, prior to re-use, first be cleaned again by single or multiple activation and spraying of the active ingredient formulation into the air.

Description of the invention

The present invention relates to a device which, building on the Respimat® technology, has the object of providing a discontinuous, i.e. occasional administration of a liquid drug formulation with reproducible dosing accuracy.

A further object is to be able in such cases to dispense with cleaning steps between the discontinuous applications.

A further object is to provide a nebulizer for the discontinuous administration of liquid drug formulations in which a drying-up of liquid in the system that threatens the pharmaceutical quality of the formulation or the pharmaceutical quality of the application is largely minimized.

A further object is to provide such a device in which the use of preservatives in drug formulations can optionally be dispensed with.

A further object is to provide such a device with which drug formulations can also be nebulized which under normal conditions (i.e. under air or oxygen atmosphere) or during non-sterile treatment quickly suffer loss of pharmaceutical quality.

Finally it is an object of the present invention to make available a device for the delivery of a dosed quantity of a drug as a liquid jet or as an aerosol of droplets by delivery of a dosed quantity of the drug under pressure by dispensing facility which does not display the aforementioned disadvantages of the known devices.

A further object of the invention is to provide a nebulizer for the preparation of an inhalable aerosol.

A further object of the invention is to provide a needleless injector for the preparation of a jet injecting itself in or through the skin of an animal/human or a human, animal or vegetable membrane.

A further object of the invention is to provide an atomizer for the application of an aerosol to the surface of the eye.

A further object of the invention is to provide a device for the dispensing of pharmaceutical liquids for needleless injection, inhalation, nebulizing etc. which satisfies the strictest hygiene requirements.

Detailed description of the invention

Contrary to the known devices which are designed as a multi-dose inhalation device or needleless injectors such that as a rule a device contains all the technology provided for the dispensing of the liquid and this device is fitted with a drug container which contains so much drug that up to several hundred single doses can be administered to the patient, the invention is based on a completely different inventive concept. According to the invention a device is provided in which the technology needed for the dispensing of the liquid is broken down into two part-aspects: according to the invention the technology necessary for the dispensing of the liquid and the components necessary for this is divided into at least two structurally separate parts. Firstly a part which provides the elements necessary for supplying the drug and the elements coming into direct

contact with the drug, and a second part which contains the elements which provide the energy for the dispensing process.
According to the invention a device for the dispensing of a liquid is thus created, and a reservoir, preferably in the form of a container cartridge, with dispensing facility integrated with it or firmly connected to this container as an integral constituent, the reservoir being fitted like a cartridge into the device for the dispensing of the liquid.

The device contains
a) means for the respective introduction and removal of the container cartridge containing the drug into and from the inside of the device and
b) means for the exertion of pressure on the container cartridge.
Within the framework of the present invention this device is also called device for pressure exertion or device.
This device is re-usable, i.e. it is designed for a large number of single activations and serves essentially to accommodate the container cartridge together with dispensing facility and provide a mechanism for the exertion of pressure on the container or the liquid in its inside and thus make possible the atomization of the fluid.

The container cartridge according to the invention itself contains, in addition to the integrated dispensing facility, means of passing the pressure created by the device onto the liquid in its inside, in order to feed pressurized liquid to the dispensing facility.

The container is also called reservoir, container cartridge or just cartridge within the framework of this description of the invention.

The container cartridge thus contains the drug and the elements of the atomization technology which can come into contact with the drug. The container cartridge represents the actual dispensing facility and can for example be developed as a disposable container, e.g. as a single-use container.

As already stated, the liquid is preferably a pharmaceutically applicable formulation, e.g. in the form of solutions or suspensions of a drug.

Through the separation according to the invention of the dispensing process into a device for the exertion of pressure and another device separate from the first device with the nozzle for the dispensing of the liquid the objects on which the invention is based are achieved. It is thereby guaranteed for example that, even if the device is not used over a lengthy period, the patient receives during the single application the quantity of drug necessary for treatment, as with every application a new container cartridge can be used in the device for the provision of the pressure exertion.

The fact that the container cartridges can be such that they accommodate only a single dose unit, i.e. only a single application is possible or the quantity and drug is sufficient for only a few doses, allows preservative-free drugs to be used. This not only results in the patient being burdened with a small quantity of antimicrobially active substances, but also a further aspect: in principle, some drugs (such as e.g. peptides) are not compatible with preservatives approved for inhalation. The freedom from preservatives that can be realized with the device according to the invention therefore allows drugs, that were previously unable to be formulated because of incompatibility with preservatives, to actually be made available.

Description of the device for the exertion of pressure

As already described, the re-usable part of the invention, namely the device with a) means for the respective introduction and removal of the container cartridge containing the drug into and from the inside of the device and b) means for the exertion of pressure on the container cartridge, build on the Respimat® technology, preferably on the principle of a device that is based on the device disclosed by WO 97/12687 and its Figure 6.

Preferably this device is similar to a cylinder in form and has a handy size of less than 9 to 15 cm long and 2 to 4 cm wide, so that the patient can carry it with him at any time. It has a bottom-side end and lying opposite a top-side end. The top-side end has to the top, i.e. in the direction opposite to the bottom region, an opening through which the liquid to be dispensed emerges from the device.

Preferably the device consists of at least three housing sections, a bottom-side housing lower section, a housing middle section and a top-side housing upper section. If the two sections housing middle section and housing upper section form a structural unit or differentiation between the two sections is not necessary in the context, both are summarized as housing upper section. Optionally the housing upper section open to the top can be sealed by a lid or a cap. This lid/cap can be an integral constituent of same or represent an element separate from it.
The housing upper section is preferably connected rotatable or swivellable with the housing middle section.

The housing lower section can be fitted onto the housing middle section in axial direction or connected to it.

The housing middle section preferably contains a spring which is tensioned against the housing middle section via a rotational movement of the housing lower section.

The housing upper section serves to accommodate the container and contains corresponding means.

The housing upper section has, parallel to the longitudinal axis of the device (= vertical direction) a continuous, preferably tubular, i.e. cylindrical bore. An optionally cylindrical cavity is thereby developed which is open on two sides. This cavity is developed to accommodate the container cartridge and within the framework of this description is also called container accommodation chamber or accommodation chamber in short. Alternatively it is called housing opening. The two openings lie opposite each other, one pointing towards the bottom of the device and when the device is closed touching the lid of the housing middle section. The other opening points towards the top part and preferably opens out into a projection, likewise open to the top, straight and tubular, which is developed on the top side of the housing upper section and whose vertical axis is preferably also developed parallel to the longitudinal axis of the device. That is to say, the vertical lying on the opening plane of the tube lies parallel to the longitudinal axis of the device. This projection can be a mouthpiece for an inhaler, an adapter for an eye bath or the like, or such a device can be connected to the projection. Such an adapter for an eye bath is described in PCT/EP0207038, to which reference is hereby

expressly made. A mouthpiece is described for example in Figures 6 a/b of WO 97/12687, reference to which is also hereby expressly made in this connection.

Through the top-side opening of the accommodation chamber an aerosol emerging from the container cartridge can leave the device through the tubular projection. The container cartridge preferably fits precisely into the accommodation chamber.

In one version a transport means can be developed in the upper housing section or attached to the upper housing section, in particular a carriage or a transport carriage, into which the container cartridge is placed and which then transfers the container cartridge into its end-position in the accommodation chamber.

The inside of the accommodation chamber is preferably such that the container cartridge can be once or more times manually pushed in and withdrawn again, but the container cartridge in the inside itself can carry out no or nearly no cross-movement. With a bottle-like container cartridge, i.e. a container with belly, shoulder and head regions, the inside of the accommodation chamber can also be developed complementary thereto, i.e. this bottle shape is copied as a negative form.

In a further version of the invention it can be provided that a part of the upper housing wall is a constituent of a removable grip which is provided with holding means for accommodating a container. Through the removal of a part of the housing wall an opening forms in this way through which the container can be introduced into the inside of the device. This removable part of the housing wall is provided with a suitable holding means with which an exact positioning of the container into its target position is particularly easily and quickly possible.

In other versions in which the housing middle section and the housing upper section can likewise be inseparably connected to each other and thus represent a structural unit, the container cartridge can be introduced into the accommodation chamber only from the latter's top-side end. Also in this case the bottom-side end of the container cartridge points towards the bottom-side end of the accommodation chamber. In such a case corresponding arresting means and guide means can be developed, analogous to those elsewhere. In this version it must be guaranteed that the container is briefly firmly

connected to the accommodation chamber in order that the container, upon exertion of pressure, is not hurled out of the accommodation chamber. In this case the container cartridge can e.g. carry an external thread and the accommodation chamber a complementary internal thread. Such a closure can also be developed as a bayonet closure, as one or more gripper arm(s), one or more holding means etc.

The housing upper section can, in some versions which contain no such transport means for the container, be connected at least partially releasable to the housing middle section. In such a case the two sections are at any rate connected to each other such that the housing upper section can be removed from the housing middle section such that the bottom-side opening of the accommodation chamber is accessible. At the same time the device includes closure means which ensure that this opening mechanism can only be carried out deliberately by the user of the device and a chance opening during the use of the device is not possible.

It can be provided that, for the introduction of the container, the housing upper section is swivelled eccentrically rotatable or swivellable about the housing middle section. Through the swivellable design with the help of e.g. a hinge or swivel joint the whole device opens and the inside of the device is accessible, so that the container cartridge can be introduced into the bottom-side opening of the accommodation chamber in the inside of the device. The advantage of this version is that the hinge or the swivel joint well illustrates the mode of operation of the mechanism and the opening is thus self-explanatory. Because of the clear operating zones, a single-dose container located in the accommodation chamber immediately becomes visible after the opening and the manner in which the container cartridge has to be replaced is clear.

In all these cases with a housing upper section mobile vis-à-vis the housing middle section, the bottom-side opening of the accommodation chamber for the container can lie in the bearing surface of housing upper section and housing middle section or touch or almost touch the housing middle section.

The opening mechanism can be such that the housing upper section is connected on the outside via an eccentric swivel joint to the housing middle section. A rotary movement of the housing upper section in the cross-plane defined by the longitudinal

axis of the device thereby becomes possible, i.e. a horizontal rotary movement in which the axis between the bottom-side end of the housing upper section and its top-side end always remains aligned parallel or roughly parallel to the longitudinal axis of the device.

It can also be provided that the housing upper section is developed as a swivelling flap. The swivelling flap comprises e.g. a hinge which is preferably arranged at the bottom of the housing upper section, so that in this way a part of the total device can be swivelled out. The vertical swivel mechanism or the horizontal rotary movement, for example a hinge or a rotation axis, has the advantage that the constituents that are swivellable relative to each other cannot be releasably separated and no part can thus be lost.

In such a case, the housing upper section can be swivelled away from the housing middle section, i.e. the axis between the bottom-side end of the housing upper sections is moved as if it were turned upside down.

The cavity of the accommodation chamber is such in such versions that the container can be pushed in therein for example coming only from the bottom-side opening like a cartridge into the barrel of a weapon. In this case the section of the container cartridge with the dispensing facility - which optionally represents an atomization facility, in the ideal case a nozzle - is aligned in the direction of the top-side opening and the bottom area of the container cartridge points in the direction of the housing lower section. The top-side atomizer facility of the container cartridge can still lie inside the container accommodation chamber, end in the accommodation chamber or project through the top-side opening. The analogous case applies to the bottom-side end of the container cartridge. The bottom of the container cartridge preferably ends plane with the bottom-side opening of the accommodation chamber.

The accommodation chamber also has means which guarantee that the container in this case can be pushed in bottom-side only and optionally further means which prevent the container from being able to be pushed fully through the accommodation chamber. These means can consist of guide rails, guide grooves or guide indentations along the vertical axis of the chamber, of stops and the like. The container then has means contrary thereto. By way of example, the bottom-side opening of the accommodation chamber can e.g. in the initial area have one or more recesses and the container has,

bottom-side, corresponding elevations which fit into the recesses. Also, at the bottom-side opening of the accommodation chamber e.g. a recess in the form of a peripheral ring can be developed. In longitudinal section the cavity of the accommodation chamber is thus T-shaped. The container can then be developed precisely complementary thereto, i.e. likewise T-shaped in longitudinal section, the „T-beam" forming the bottom of the container. In this case the container can have, bottom-side, a ring which thickens the outer casing so that it fits into the area of the recess, but no longer into the area with the smaller diameter of the accommodation chamber.
Also, at the top-side end of the accommodation chamber, a stop can be developed which ensures that e.g. the container cannot be pushed fully through this opening. The stop, e.g. in the form of a tapering opening or a peripheral edge developed to the inside, can be developed so that the top end of the container or, in the case of a bottle-shaped container, its shoulder strikes against the stop. Since, according to the invention, the dispensing facility preferably forms the top end of the container cartridge, i.e. in the case of a bottle-like container cartridge the neck of the bottle, such a stop can lead to the dispensing facility being held by the stop or else the container cartridge is held underneath the dispensing facility in the shoulder area and the dispensing facility itself projects through the opening into the tubular projection.

In all versions the accommodation chamber and the container are designed such that the container cannot be hurled out of the device for the exertion of pressure by the pressure piston. In all versions the container cartridge can be firmly connected to the accommodation chamber such that the cartridge cannot be hurled out by the pressure piston at the top-side end of the accommodation chamber.

A preferred version has, for the housing upper section as further component, a swivellable and arrestable protective cap which covers at least the tubular projection and thus the top-side opening of the accommodation chamber or the upper lid area. It is thus guaranteed that the areas of the device that lie further within are protected. This is important in particular if the device is kept in the trouser pocket or a handbag. In order that the protective cap itself does not unintentionally leave its arrested position, it can provided that the protective cap has a tongue-shaped section which can be locked in a tongue-shaped recess of the housing. This protective cap can be developed so that in

the closed state it covers the release button of the device which is developed in the housing middle section, and thereby prevents an unintentional release.

The housing middle section accommodates an energy storage means for the generation of pressure on the container and a mobile element which is moved by the release of the stored energy and thereby directly or indirectly exerts pressure on the container cartridge or on the liquid located in its inside.
The energy storage means is preferably an elastic element, for example a compression spring. However, the pressure can also be exerted by means of other elements for example a motor.
In the case of a compression spring as energy storage means this can be arranged in a compression spring housing which is located at least partly in the housing middle section and optionally is connected to this via snap closures. Preferably, at least a part of the compression spring housing projects bottom-side from out of the housing middle section, i.e. the compression spring housing is longer than the housing middle section. In this case the compression spring housing or a part of it can be housed rotatable by means of a swivel joint in order to tension the compression spring via a rotary movement and a locking clamping means. The compression spring can then be relaxed again by a release mechanism.
The mobile element can be a piston (pressure piston) which is moved by the compression spring movement itself. It is fired in the direction of the container bottom by the relaxing of the compression spring and thereby exerts pressure on the container. The pressure piston can be connected to the compression spring via a drive flange, in this case being firmly connected to the drive flange. The pressure piston is preferably guided over a bore in the otherwise closed lid area of the housing middle section. Optionally, the top-side part of the pressure piston can be guided in a cylindrical element (guide cylinder) which is developed in the lid area of the housing middle section. In the tensioned state of the compression spring the pressure piston is wholly in the housing middle section. In the relaxed state the upper end of the pressure piston is located in the housing upper section and pierces a container cartridge situated there. The pressure piston has a vertical movement play of up to some centimetres, preferably less than 2 cm, particularly preferably between 0.1 and 1.5 cm.

The pressure piston can be developed as a hollow or solid piston and after activation exerts high pressure on the container.
The locking clamping means contain the said compression spring, preferably a cylindrical helical compression spring, as storage means for the mechanical energy. The locking clamping means preferably have a vertical longitudinal axis. In the following a version of the locking clamping means is described. The compression spring acts on a drive flange as spring piece , the movement of which is determined by the position of a locking member. The path of the drive flange is precisely limited by an upper and a lower stop. The compression spring is preferably tensioned via a force-transmitting gear system, e.g. a screw sliding gear system, by an external torque which is produced upon the rotation of the housing middle section against the compression spring housing in the housing lower section. In this case the housing middle section and the drive flange contain a single- or multi-gear V-gear system.
The drive flange is pressed against the force of the compression spring into the compression spring housing.

The compression spring can be kept in the tensioned state via a locking member. This locking member has meshing locking surfaces and is arranged in the form of a ring round the drive flange. It consists e.g. of a ring made of plastic material or metal. The ring is arranged in a plane perpendicular to the atomizer axis and is housed mobile in this plane. After the tensioning of the compression spring the locking surfaces of the locking member move into the path of the drive flange and prevent the relaxing of the compression spring. The locking member is released by means of a key (release key), which is likewise developed at the housing middle section. This release process can be effected by pressing the key. The release key is connected or coupled to the locking member. For the release, the release key is moved parallel to the ring plane, preferably into the atomizer; in the process the ring will move in the ring plane. Design details of the locking clamping means are described in WO 97/20590, as regards the locking mechanism reference is made to Figure 3 following this patent application. Alternatively to this the ring can be radially elastically deformable. In this case the ring is deformed when the release key is moved for the release. A movement of the ring in the ring plane is not necessary.

At the housing upper section and/or housing middle section means can be developed which connect the two sections releasably to each other so that a separation, swivelling open etc. of the two sections during the pressure release is not possible.

In such cases the housing middle section is connected to the housing upper section via a closure which prevents the housing upper section from unintentionally opening.
To this end the housing middle section can have means of blocking (blocking means) the release mechanism which prevent the exertion of pressure being released when the device is open, i.e. as long as the housing upper section is not firmly connected to the housing middle section.

The housing middle section can also have means which prevent the device from being opened (the housing upper section from being opened) as long as the compression spring is relaxed, and the piston thus projects into the housing upper section (closure arrest means).

A preferred version has both blocking means and closure arrest means.

Preferably the blocking means are such that they prevent the movement of the locking member (see locking clamping means) in the direction into which the locking member is forced in order to relax the compression spring. Such a means can be a spring-loaded locking bolt which, seen from horizontal plane from the push button, lies vertically behind the locking member. In the opened state of an e.g. tiltable housing upper section a spring forces the locking bolt somewhat upwards out of the housing middle part. In the closed state the housing upper section forces the locking bolt against the spring back into the starting position. The locking bolt can be cylindrical, square and the like and is either so configured or so guided that the locking bolt prevents the horizontal movement of the locking member that is necessary for the release when the device is open and releases the locking member when the device is closed. For example, the locking bolt can have recesses which, in the closed state of the device, free the path of the locking member for the relaxation of the compression spring.
The locking bolt can, in alternative versions, also arrest the release key so that this can be pressed in only when the device is closed.

Analogous blocking means can be developed for versions of the device in which the housing upper section is housed eccentrically rotatable vis-à-vis the housing middle section.
In these cases the locking bolt is pressed via the torque back into its starting position, and thus frees the path for the locking member or the release key.

The closure arrest means are preferably coupled with the closure between the housing upper section and housing middle section. It prevents the housing upper section from being opened as long as the pressure piston projects into the housing upper section, i.e. the compression spring is relaxed. It then controls the release of the closure key.

In a preferred version the closure mechanism can be operated via a closure key that can be pressed in. This closure key is coupled with an arrester bolt which is housed horizontal or at least skewed to the longitudinal axis of the pressure piston. This arrester bolt can be housed against a spring. In the tensioned state of the compression spring, the arrester bolt can be pushed above the pressure piston into its guide channel and in this position releases the closure key to the extent that the closure mechanism can be opened.

In alternative versions the pressure piston itself can have elements, such as projections etc. against which the arrester bolt presses or on which it comes to rest as long as the pressure piston projects into the housing upper section. The release movement of the arrester bolt is thus prevented as long as the pressure piston is not wholly sunk into the housing middle section.

The housing lower section is located underneath the housing middle section. In preferred versions it is pushed axially over the compression spring housing until the housing lower section and the housing middle section touch, while the compression spring housing is located inside the space thereby formed.
The housing lower section is connected to the compression spring housing via a releasable connection, e.g. a plug-and-socket connection or unreleasable connection.

Upon operation of the device the housing middle section is rotated against the housing lower section, the housing lower section taking the compression spring housing with it.

The compression spring is compressed via the screw sliding gear system and tensioned, and the locking means automatically engage. The angle of rotation is preferably a whole fraction of 360 degrees, e.g. 180 degrees. Simultaneously with the tensioning of the compression spring the drive part in the housing middle section is moved a predetermined distance and the pressure piston guided by the cylinder in the lid area of the housing middle section is drawn back. Further design details are disclosed in the PCT applications WO 97/12683 and WO 97/20590, to the contents of which reference is hereby made.

Description of the container cartridge

The container cartridge is a dimensionally stable container which cannot be deformed by manual pressure, i.e. it is plastically deformable along neither the longitudinal axis nor its transverse axis. Preferably the piston is conceived such that it is dimensionally stable vis-à-vis a pressure difference from inside to outside of 49 to 599 bar, preferably 149 to 299 bar.

As already stated, the container or the single-dose cartridge is firmly connected as a disposable part to a facility for the dispensing of a liquid, for example a nozzle. That is to say, this facility is an integral constituent of the container. Thus the device for the exertion of pressure (the device) no longer needs its own dispensing facility, so that this device for the exertion of pressure as such is structurally simplified vis-à-vis the devices of the Respimat® mark known from the state of the art.

The container cartridge is preferably of cylinder-like or bottle-like design. The container can also be designed in cartridge form or in imitation of the shape of an inhalation capsule. The outer shape of the container need not be a faithful copy of a cylinder, a bottle, cartridge or inhalation capsule, but preferred versions resemble one of the objects. The shape of an inhalation capsule can be seen in the figures of EP 1100474, reference to which is hereby made. Such capsules can be described as cylinder-like structures with two semicircular ends. The container cartridge has a bottom-side and a top-side end, the bottom-side end pointing towards the bottom-side end of the device for the exertion of pressure when the container is fitted into this device. Correspondingly, the top-side end of the container cartridge points towards the top-side end of the device for the exertion of pressure.

The container cartridge is preferably a single-dose container or a single-dose cartridge. This container has a hollow cylinder to accommodate the fluid (stock cylinder), the actual stock chamber, which also functions as a pressure chamber during use. There can be located bottom-side in the stock cylinder a movably arranged element (movable container punch, e.g. in the form of a piston (container piston) or preferably a ball (container ball)), which seals off the fluid to the outside. The facility for the dispensing of the liquid is arranged at the top-side end of the container. The movably arranged container punch, the stock chamber and the dispensing facility are arranged in series so that a liquid which is located in the stock cylinder, i.e. in the stock chamber, is pressed through the dispensing facility when the container punch is pushed into the stock chamber by a force acting from outside. During use the force acting from outside is the force which is exerted by the pressure piston on the container punch. In the case of a drug solution or suspension as stored liquid, this is fed to the atomization facility, for example an atomizer nozzle, which for its part ensures the atomization of the drug.

The dispensing facility can be an atomization facility.

Optionally the bottom-side opening and the top-side opening of the stock cylinder can have a sealing means or several sealing means.

The sealing means of the bottom-side opening can be arranged either bottom-side of the container punch or in top-side direction. Preferably the container punch itself seals off the bottom-side opening. Optionally a sealing film is applied bottom-side to the bottom-side opening.

The sealing means of the top-side end can likewise be arranged in bottom-side direction, i.e. before the dispensing facility or after it, thus top-side. Preferably it is arranged top-side, i.e. the opening or the openings of the dispensing facility is (are) sealed, e.g. by a manually detachable sealing film.

Preferably it is provided that the stock cylinder inside the container has a supply stock capacity of at most 1 ml, capacities of at most 100 microlitres being preferred, e.g. for eye treatment, and capacities of less than 50 microlitres particularly preferred. For nasal

application, capacities of up to 30 microlitres can be preferred and for pulmono-inhalative application capacities of up to 15 – 20 microlitres are most strongly preferred. This quantity of drug is sufficient for the administration of a single dose and avoids the use of a preservative, as desired.

In a preferred version the stock cylinder has a constant internal diameter over the whole longitudinal axis. The bottom-side and top-side openings are perpendicular to the longitudinal axis on the upper side or lower side of the stock cylinder. Both openings extend over the whole diameter of the stock cylinder.
The container preferably has a height of up to 4 cm, more preferably up to 2.5 cm, particularly preferably up to 2 cm. The stock cylinder has a corresponding length in its inside, with a corresponding ratio of length to cross-section, in order to provide the whole filling capacity. The diameter of the cross-section is preferably up to 5 mm, more preferably up to 3 mm and particularly preferably up to 2.5 mm.

The container punch lies with a precise fit in the stock cylinder and is preferably made from a plastic material. This can be for example: polytetrafluoroethylene, ethylene-propylene-dienepolymer, silicon, elastomers, thermoplastic elastomers, such as Santoprene® and others.

Preferably the container punch lies exclusively inside the stock cylinder and more preferably the bottom-side end of the container piston ends bottom-side in the container, i.e. the container punch does not project outwardly beyond the bottom of the container and therefore also cannot be accidentally moved during storage, transport and the like.

The container punch is dimensioned for a precise fit or approximately precise fit, so that it closes the stock cylinder tight on the one hand, but on the other hand can be moved into the stock cylinder when a force is exerted.
By precise fit or approximately precise fit is meant that the container punch occupies the stock cylinder according to the cross-section, optionally the diameter of the container piston that is responsible as regards the closure of the stock cylinder can be up to 5% wider than the diameter of the stock cylinder. By approximately precise fit is meant that

this diameter of the container punch is slightly smaller than the diameter of the stock cylinder.

Preferably the container punch is developed as a container punch with precise fit. Such a variant can be of advantage when filling the stock cylinder, but also when guiding the container stamp through the stock cylinder.

The container punch can have a slightly greater external diameter than the internal diameter of the stock cylinder, especially when it is situated in the closure position inside the stock cylinder. A better closure of the bottom-side opening is thereby achieved. In addition this has the advantage that the container punch completely empties the stock cylinder when the container punch is pushed through the stock cylinder.
In one version the container punch is a cylinder.

A cylindrical container punch can have a recess in the form of a cavity which is open to one side. The opening of the recess points towards the bottom-side opening of the stock cylinder, i.e. in the direction of the pressure piston. The internal diameter of the opening or of the recess is greater than the external diameter of the pressure piston of the device for the exertion of pressure. In cross-section the container piston then has the shape of a U optionally with edges developed as corners. The bottom of the recess forms the point on the container piston at which the pressure piston can engage in order to press the container piston in the stock cylinder. The advantage of this design and arrangement is that the container piston can taper slightly, because of the pressure of the pressure piston on the bottom of the recess, at the opposite end, that is on the side of the container piston which forms spear tips upon penetration of the reservoir. That is to say, because of the pressing of the pressure piston, there is a change in cross-section in the shape of the container piston from the U-shape into approximately a V. A simplified passage of the container piston through the stock cylinder is thereby achieved. A further advantage of this change of shape, caused by the pressure of the pressure piston, of the container piston is a reduction in the pressure of the pressure piston on the walls holding the container piston, so that even a firmly seated container piston can be released and moved from the pressure piston without tilting.

In order to prevent a tilting of the container punch, guide facilities, e.g. guide rails or guide vanes etc., can also be developed at the container punch and / or the side wall of the stock cylinder.
To improve the sliding of the container punch through the stock cylinder, the container punch or the wall of the stock cylinder can be coated with a pharmacologically compatible lubricant. Such lubricants are known from the state of the art and include e.g. sorbitan esters, e.g. sorbitan trioleate, oleic acid, lecithin and other fatty acids, fatty alcohols, esters of fatty acids and the like.

In other structurally similar containers, the container punch can be part of the rigid and inflexible baseplate of the container. In this case the pressure piston penetrates the baseplate of the container and then presses into the stock cylinder. In such cases theoretical fracture points can be developed on the baseplate, so that the pressure piston can more easily push out the integrated container punch from the baseplate during the exertion of pressure.
In these cases the pressure piston can be dimensioned such that no liquid is forced out of the reservoir past the pressure piston bottom-side from the container.

In other versions the bottom-side opening of the stock cylinder is closed only by a flexible sealing means, e.g. a sealing film and the like. Preferably the sealing means are not indestructibly removable from the container. In this case the pressure piston assumes the function of the container punch.

The dispensing facility, which can be an atomization facility and which is integrated with the container according to the invention, can be a special nozzle, as described for example by WO 94/07607, WO 99/16530 or the German patent application with the application number 10216101.1. Reference is hereby expressly made to all the documents.

In the simplest case the nozzle is a kind of perforated shutter, i.e. the nozzle represents a body with a single central continuous bore.

Another version of the nozzle is a body with at least two or more continuous bores which run parallel to each other or are inclined towards each either. In the case of bores

inclined towards each other, the side with the acute angle forms the nozzle outlet side, the other side accordingly the nozzle inlet side. In the case of at least two bores the inclination angle is preferably 20 degrees to 160 degrees, preferably 60 to 150 degrees, particularly preferably 80 to 100°.

The nozzle openings are preferably arranged at a distance of 10 to 200 micrometres, more preferably at a distance of 10 to 100 micrometres, particularly preferably 30 to 70 micrometres. 50 micrometres are most strongly preferred.
The dimensions of the nozzle openings and nozzle channels correspond to those of the versions described in the following.

The nozzle can consist e.g. of glass, silicon, plastic material, such as PBT (polybutadiene terephthalate), PP (polypropylene), PC (polycarbonate) and others.

Another version of the nozzle is described in EP 0860210. In particular reference is hereby expressly made to the drawings of this patent specification. Such a nozzle consists of two parts, a base part and a top part, which are laid one above the other in order to thereby form the actual nozzle block. These two single parts can have microstructures which can be obtained e.g. by etching. Preferably the two parts are developed as plates and the microstructures form in the inside of the nozzle block a liquid connection from one side to the other, namely from the nozzle inlet side to the nozzle outlet side. There is at least one round or unround opening on the nozzle outlet side. Preferably these openings or, in the case of several, all these openings, have a depth of 2 to 10 micrometres and a width of 5 to15 micrometres, the depth preferably being 4.5 to 6.5 micrometres and the length 7 to 9 micrometres.
In the case of several nozzle openings, two are preferred, the jet directions of the nozzles in the nozzle body can run parallel to each other or they are inclined towards each other in the direction of the nozzle opening. In the case of a nozzle body with at least two nozzle openings on the outlet side, the jet directions – and this is preferred – can be inclined towards each other, in order to atomize the liquid through the impact. In this case the inclination angle is preferably 20 degrees to 160 degrees, preferably 60 to 150 degrees, particularly preferably 80 to 100°.

The nozzle openings are preferably arranged at a distance of 10 to 200 micrometres, more preferably at a distance of 10 to 100 micrometres, particularly preferably 30 to 70 micrometres. 50 micrometres are most strongly preferred.
The jet directions accordingly meet in the area around the nozzle openings.
The two individual parts can be worked from glass, silicon or a plastic material.
Preferably the microstructures are etched into a silicon plate. Both parts have at least one essentially flat surface. When the two parts are laid one above the other, these two surfaces lie one on the other.
For the sake of simplicity a version is described in the following in which only the base part has relief-like microstructures, but not the top part. In other versions the situation is exactly the opposite or both parts have these microstructures.
A set of channels can be developed on the base part on the flat surface, in order, in cooperation with the essentially flat surface of the top part, to create a large number of filter passageways (filter channels). The base part can also have a plenum chamber, the lid of which is again formed by the top part. This plenum chamber can be located up- or downstream from the filter channels. Two such plenum chambers can also be developed. Another set of channels on the essentially flat surface of the base part, which – if present – is located downstream from the filter channels, forms together with the top part a set of channels which create a large number of nozzle outlet passageways.
The overall cross-section surface-area range of the nozzle outlets is preferably 25 to 500 square micrometres. The overall cross-section surface-area range is preferably 30 to 200 square micrometres.
In another version this nozzle structure also has only a single nozzle opening.
In other versions of this type the filter channels and/or the plenum chamber are missing.

The filter channels are preferably formed by projections which are arranged in zig-zag form. Thus for example at least two rows of the projections form such a zig-zag configuration. Several rows of projections can also be developed, the projections are in each case offset laterally relative to each other, in order to thereby build up second rows skewed to these rows, these last-described rows then forming the zig-zag configuration.
In such versions the inlet and the outlet can each have a longitudinal slot for unfiltered or filtered fluid, each of the slits being essentially exactly as wide as the filter and essentially exactly as high as the projections on the inlet or outlet sides of the filter. The

cross-section of the passageways formed by the projections can in each case stand perpendicular to the direction of flow of the fluids and can - seen in direction of flow - decrease from row to row. The projections which are arranged nearer to the inlet side of the filter can also be larger than the projections which are arranged nearer to the outlet side of the filter. In addition the distance between the base part and the top part can reduce in the area from the nozzle inlet side to the nozzle outlet side.
The zig-zag configuration which is formed by the at least two rows of projections has an inclination angle alpha of preferably 20° to 250°.

Further details of this nozzle structure can be found in WO-94/07607. Reference is hereby made to the contents of this document, in particular to figure 1 and its description.

The described nozzles can be connected to the opening of the container via a nozzle holder. Such a nozzle holder is in the simplest form a ring or body with an opening into which the nozzle can be fitted. This opening covers the nozzle block over its whole generated surface, i.e. the surface that stands perpendicular to the preferably linear axis which is formed by the nozzle inlet side and the nozzle extent side. The holder is open to the top and bottom, in order to prevent further the supply of liquid to the nozzle inlet side of the nozzle, nor the dispensing of the liquid. This holder can in turn be fitted into a second holder. The outer shape of the first holder is preferably conical. The opening of the second holder is formed accordingly. The first holder can consist of an elastomer.

The dispensing facility is connected in form-locking manner to the container and to this end is preferably screwed or crimped to the container via a screw cap or crimping sleeve with in each case an open side, which is particularly economical. Alternatively the form-locking connection can also be achieved by gluing or welding, in particular by means of ultrasonic welding.
In each case the connection is such that the nozzle opening lies free and cannot be blocked by the closure.

In the case of a needleless injector the nozzle is such that a sharp liquid jet is produced thereby. A funnel-shaped shield (hopper) can be developed around the nozzle, the narrowing end of which surrounds the nozzle. In this case the nozzle can be introduced

via the top-side opening of the accommodation chamber into the latter. The hopper then projects from out of the top-side opening of the accommodation chamber.
During use the broad opening of the hopper is placed onto the point on the skin into which the liquid is to be injected. A spraying of the liquid is prevented by this measure. In other versions this function can be taken over by the tubular projection of the device for the exertion of pressure if this is accordingly developed, i.e. the projection which forms a mouthpiece in the case of an inhaler.

Through the device according to the invention for the exertion of pressure, a pressure is to be created in the container cartridge which presses the drug in the container with an entry pressure of up to 600 bar, 50 bar to 600 bar, particularly preferably 200 to 300 bar on the nozzle body and thus atomizes it via the nozzle openings e.g. into an inhalable aerosol. The preferred particle sizes of such an aerosol are then up to 20 micrometres, preferably 3 to 10 micrometres. In order to be able to build up this pressure, the dimensions of the pressure piston width, the length of stroke of the pressure piston, the diameter of the container piston, the capacity of the stock cylinder which now functions as pressure chamber and the force of the compression spring are chosen in accordance with the physical laws.

In addition to the advantages, described at the outset, of the invention, through the container according to the invention more highly concentrated nanosuspensions, i.e. suspensions in which the suspended particles are ca. 100 – 500 nm in size, can without complications be dispensed as a jet or atomized without the single use resulting practically in a blockage of the nozzles.

Via the device according to the invention, solutions or suspensions with every type of medico-therapeutically and/or medico-prophylactically effective substances are preferably dispensed. These include not only low-molecular, mostly chemico-synthetically produced, pharmacologically active substances, but also proteins, peptides, other biomacromolecules or vaccines which can be dispensed in such a device without substantial loss of activity. Reference is made to the contents of EP 1003478.

According to the invention, several replaceable reservoirs containing the fluid to be dispensed can optionally be pushed one after the other into the device for the exertion of pressure and used. The reservoir contains the corresponding pharmaceutical preparations or aerosol preparation. In such cases the device for the exertion of pressure can be fitted with a revolver magazine or a magazine for rapid-fire pistols etc. In addition the device for the exertion of pressure can then include means which accordingly allow an automatic loading of the accommodation chamber with the reservoir cartridge.

The dispensing process is started by lightly pressing the release key. The locking means free the path for the drive part. The tensioned compression spring pushes the pressure piston into the stock cylinder of the container. The fluid emerges from the nozzle of the container – optionally in atomized form.

As already described, for an inhaler per stroke capacities of 10 to 50 microlitres are preferably atomized, capacities of 10 to 20 microlitres are particularly preferred, a capacity of 15 microlitres is quite particularly preferred.

All the components of the device for the exertion of pressure or of the container cartridge are made from a material suited to the function. The housing and – if the function allows – also other parts are preferably made from plastic material, e.g. by injection moulding. For medical purposes – if necessary – physiologically harmless materials are used.

The invention is preferably used as an atomizer of liquid drug preparations.

Description of the figures

The invention will be described in more detail in the following with reference to embodiments.

Figure 1 shows a cylinder-symmetrical version of the device according to the invention.

Figure 2 shows a device including container cartridge.

Figure 3 shows a version with a removable grip for accommodation of the container cartridge.

Figure 4 shows a version with housing middle section 2b and housing lower section 3 swivellable vis-à-vis the housing upper section 2a.
Figure 5 shows a further version of the device.
Figures 6a and 6b show the opening of the protective cap of the device.
Figure 7 shows a device with swivellable housing upper section 2a and its loading with the container cartridge.
Figure 7 schematically describes a version of the device.
Figure 8 schematically describes a further version of the device with swivellable arm.
Figure 9a schematically describes the process of loading the device with the container, the housing upper section 2a being rotated horizontally vis-à-vis the housing middle section 2b and housing lower section 3.
Figure 9b schematically describes the process of loading the device with a swivelling mechanism with the container.
Figure 10 and Figure 11 describe the pressure-exertion means in the form of a locking clamping means.
Figures 12 and 13 show the locking mechanism.
Figure 14 describes a version of the container cartridge.
Figure 15 describes a dispensing facility, preferably for the atomization of a liquid.
Figures 16 and 17 describe the device in cross-section.
Figures 18a to 18d show the container cartridge according to the invention.

Figure 1 shows a device 1 according to the invention in a cylinder-symmetrical version. It consists of a housing upper section 2a, the housing middle section 2b, which are also both together numbered 2 as a structural unit, and housing lower section 3. The upper housing section 2 is covered by a protective cap 7. The device 1 has an opening 4 through which a view into the inside is made possible. There is located at the centre of the axis of symmetry 5 a mobile element in the form of a pressure piston 6 above which in direct manner the container cartridge 10 (cf. Fig. 2) lies. Through succeeding movement of the protective cap 7 parallel to the axis of symmetry 5 in the direction of the arrow, the device 1 is closed and is ready for use, in which e.g. an aerosol emerges in droplet form from the opening 9. In order to prevent an inadvertent opening, a locking mechanism 8a, 8b is provided.

Figure 2 shows a likewise cylindrically designed device 1 in which, after the removal of the protective cap 7, the container cartridge 10 is introduced from above into the inside of the device 1. To this end, the container cartridge 10 is guided along the axis of symmetry 5 in the direction of the pressure piston 6. The container cartridge 10 has on both sides a groove 11 which is then surrounded by the arms of the holding means 12. The nozzle or dispensing facility of the container cartridge is identified as feature 29. Via a movable button 13 which is moved by the user in the direction of the arrow, a transport carriage 14 is activated which moves the container cartridge 10 in the direction of the pressure piston. When the device is used, the compression spring 16, in cooperation with a clamping element 15 (drive flange), ensures the rapid movement of the pressure piston 6 along the axis of symmetry in the direction of the container cartridge 10. This has a stock cylinder, not represented in the drawing, into which the pressure piston 6 cuts during the release procedure and in the process, by advancing a stopper (container piston, not shown) fitted into the container 10, pushes the drug solution located in the stock cylinder through the dispensing facility (not represented in the drawing) located at the container cartridge 10. The aerosol passes out from the dispensing facility, i.e. in this case an atomization facility, via the mouthpiece 17 to the outside.

Figure 3 shows a version in which a part of the external wall of the device is cut out and forms a grip 18 which is provided with a holding means 12 for accommodating the container cartridge 10. The container cartridge 10 centrally has a dispensing facility 29. After the grip 18 is fitted with a new container cartridge 10, the grip is introduced in the direction of the arrow and is ready for use.

Figure 4 shows a version in which the housing lower section 3 and the housing middle section 2b are shown simplified as a unit. The housing upper section 2a can be swivelled vis-à-vis the housing middle section by means of a hinge 19. To this end, the detent 20 is firstly operated in order that the housing middle section 2b together with the housing lower section 3 is transferred from its starting position A into its final position B. In the swivelled-out position of the housing middle section 2b plus housing lower section 3, the container 10 can be introduced into the housing upper section 2a or replaced.

Figure 5 shows a version in which a part of the device 1 can be swivelled out as a swivelling flap 21. In the swivelled-out position, a view into the inside of the device is possible, and in Figure 5 can be seen a compression spring 16 for moving the pressure piston 6 which, in the case of use, acts on the container cartridge 10 which is fixed in a target position by a holding means 12. After the device 1 is fitted with the container cartridge 10, the swivelling flap 21 is swivelled in the direction of the arrow to the axis of symmetry. The release is carried out via the release button 22.

Figures 6a and 6b show the device with closed and opened protective cap 7. The housing upper section 2a is provided via a hinge 48 with a protective cap 7, which is initially swivelled outwards and thus reveals the mouthpiece 17. The protective cap 7 can lock into the closure position on the housing upper section 2a via the flap 23. The protective cap 7 also has a tongue-shaped section 24. This section 24 covers the tongue-shaped area 25 in which the release key 35 is located. In the closed state of the protective cap 7 the release key 35 cannot therefore be unintentionally pressed.
The closure key 47 is located at the housing middle section 2b. If this is activated, the housing upper section can be swivelled up around the hinge 48 (Figure 7). In this position can be seen the arrester bolt 49, connected to the closure key 47, which ensures that the housing upper section 2a can be opened only when the compression spring 16 is tensioned. In this position the container cartridge 10 can be pushed into the accommodation chamber 30 (dashed) (along the dashed marking).

Figure 8 shows a version with a slightly L-shaped housing 26 with a mouthpiece 17 located thereon. A hinged arm 27 allows the mechanical drive unit 28 to be extended, and thus the container cartridge 10 to be introduced into or removed from the dashed-line accommodation chamber 30. After a suitable fitting of the device 1 with the container cartridge 10, the hinged arm 27 is pulled back, so that the device reaches its operating position.

Figure 9a shows a variant with a housing upper section 2a housed eccentrically rotatable. In this case the container 10 can be introduced into the accommodation chamber 30 only when the housing upper section 2a is rotated out laterally, i.e. horizontally vis-à-vis the housing middle section 2b. In this position the container 10 can be introduced into the dashed-line position, and then the additional part pushed back.

Figure 9b shows in several snapshots from left to right the fitting of a device with a mechanism in which the housing upper section 2a can be opened only if it is first moved vertically against the housing middle section 2b.

Fig. 10 shows a longitudinal section through a locking clamping means. The upper cylindrical housing section 2, which in this case represents exclusively the housing middle section 2b, housing upper section 2a is not shown, grips over the compression spring housing 31 to which it is connected via snap catches 32. The snap catches 32 are attached to the outside of the compression spring housing 31 and extend over two circle segments lying opposite each other, each of roughly 30 degrees. They engage in a peripheral groove on the inside of the upper housing section 2. The housing lower section can be inverted over the compression spring housing and is connected via connection means (locking means) to the compression spring housing 31 removable but not rotatable against each other (the connection is not shown). The housing middle section 2b or the housing section 2 and the compression spring housing 31 are rotatable against each other. Through the connection of the compression spring housing 16 to the housing lower section 3, the two housing sections 2 and 3 and in particular 2b and 3 are also rotatable against each other. Located in the compression spring housing 31 is the compression spring 16, which generally is already pretensioned when the two housing sections are put together. The compression spring 16 rests on a peripheral projection at the lower end of the compression spring housing 31 and on the drive flange 33, which is arranged movable in axis-parallel manner between the upper housing section 2 and the compression spring housing 31 and for its part presses against the upper housing section 2. The pot-shaped drive flange 33, which carries the pressure piston 6, projects into the upper housing section 2. The ring-shaped locking member 34 encloses the drive flange 33. The release key 35 attached to the locking member projects laterally from out of the upper housing section.

In the case of a screw sliding gear, the collar of the pot-shaped drive flange 33 generally contains two saw-tooth-shaped recesses, on which two saw teeth in the upper housing section glide (not shown). Upon rotation of the upper housing section 2 against the housing lower section 3 and thus against the compression spring housing 31, the drive flange 33 is pressed against the force of the compression spring 16 further into the

compression spring housing 31. As soon as the upper edge of the drive flange 33 has been pushed far enough down through the locking member 34, the ring-shaped locking member 34 moves perpendicular to the housing axis between the upper edge of the drive flange and a ring-shaped projection 34 in the upper housing section 2 and holds the drive flange 33 and the compression spring 16, additionally tensioned by the movement of the drive flange, firmly in the reached position.

The average compression spring force is 10 to 150 N. Between the upper and the lower resting position of the drive part, the compression spring force changes by roughly ± 10% of the average compression spring force.
By pressing the release key 35 the ring-shaped locking member 34 is pushed back perpendicular to the housing axis, as a result of which the path of the drive flange 33 is freed. The compression spring 16 pushes the drive flange 33 up for a predetermined distance and thus operates the pressure piston 6, connected to the drive flange 33, which is guided in the guide cylinder 38.

In Fig. 12 the locking clamping means is shown with the drive flange 33 in its upper resting position and with the locking member 34 released. Fig. 11 shows the locking clamping means with the drive flange 33 in its upper resting position and with the locking member 34 engaged. The stop 36 is the path limit for the drive part 33 in its lower resting position, the stop 37 is the path limit in its upper resting position. By rotating the two housing sections against each other, the position according to Fig. 10 changes into the position according to Fig. 11. By pressing the release key 35 the position according to Fig. 11 changes into the position according to Fig. 10.

Figs. 12 and 13 show a cross-section through the locking clamping means in the middle of the ring-shaped locking member, Fig. 14 corresponding to the position of the locking clamping means according to Fig. 12 in released position of the locking member 34 and Fig. 15 corresponding to the position of the locking clamping means according to Fig. 13 in engaged position of the locking member 34.

Figures 14a to e show the container cartridge 10 according to the invention. Located top-side is the dispensing facility 29, conducting a liquid, [which] is connected to the

outlet of the stock cylinder 40. The bottom-side end of the stock cylinder 40 is closed by the container piston 39.
The opening of the dispensing facility 29 is closed by an upper sealing means 58. The container piston 39 is closed to the outside by the lower sealing means 59. The dispensing facility 29 is held by one or more holders 60.
In Figure 14a the holder 60 is connected in form- or material-locking manner (e.g. welded or glued) to the container cartridge 10. In Figure 14b it is held by a crimping sleeve 61, in Figure 14c by a screw cap 62. In Figure 14e the crimping sleeve 61 surrounds the container from the top area to the bottom. In all the versions shown the baseplate 63 is wider than the container belly. The holding means, such as crimping sleeve or screw cap, are such that they free the opening of the dispensing facility 29, i.e. do not cover this opening.

In all the illustrated versions the container cartridge is pushed bottom-side into the housing upper section until the baseplate 63 encounters the edge delimiting the bottom-side opening of the accommodation chamber 30.

Figure 15 shows a cross-section through the preferred nozzle structure 41. The figure shows the relief-like microstructure of the base part 42. The area 43 represents the non-etched part of the plate. The figure shows only one nozzle opening 44 instead of preferably two channels inclined towards each other with nozzle openings. The projections forming the zig-zag-configurated filter bear the reference number 45. The nozzle inlet side bears the reference number 46.

Figure 16 shows a preferred version of the device in cross-section. This representation shows the locking clamping means described by Figures 10 and 11 and differs only slightly from the device described there, in particular in the design of the pressure piston 6 and of the drive flange 33. Compared with the version according to Figures 9 and 10 the device in this version has blocking means which prevent the exertion of pressure caused by the pressing of the key 35 from being released as long as the housing upper section is open. In this version these blocking means consist of a locking bolt 50 which is housed bottom-side against a spring 51. Top-side, the locking bolt touches the bottom of the housing upper section 2a. The locking bolt has areas with larger and smaller diameters. It is situated behind the locking member 34. In the closed position of the

device a recess 52 developed at the locking bolt 50 lies behind the locking member 34 and thereby frees the path for the locking member. In the opened position of the device the spring 51 of the locking bolt presses slightly upwards, so that the wider area 53 of the locking bolt 50 comes to rest behind the locking member 34 and thus blocks the release of the locking member. The release key 35 cannot be pressed in this position. In alternative versions, the spring 51 is connected top-side to the locking bolt and the mechanism is mirrored accordingly. Figure 16 shows the closed device with tensioned compression spring 16, i.e. the top of the pressure piston 6 still lies in the housing middle section 2b.

Figure 17 shows another cross-section plane of the version according to Figure 16 with the spring relaxed. The top of the pressure piston 6 has forced the container piston 39 into the container cartridge 10 and the liquid has been extracted from the latter through the nozzle 29. In this perspective the closure between housing lower section and compression spring housing 31 is represented under the reference number 64. The closure can be releasable or fixed, it can be achieved via a snap spring and the like. The closure arrest mechanism can also be recognized from this perspective. The closure key 54 is developed at the housing upper section 2a or at the housing middle section 2b. In the closed position of the device this touches one end of the horizontal arrester bolt 55 which is elastically housed against the spring 56. The other end of the arrester bolt lies on the pressure piston. The closure key 54 cannot be operated in this position. Only when the compression spring 16 is tensioned by rotation of the housing lower section 3 against the housing middle section 2b, the compression spring housing 31 being entrained via the closure 64 by the housing lower section, the pressure piston 6 guided back into the housing middle section, is the path for the arrester bolt released out from this position in the direction of the pressure piston. In this position the closure key 54 can be pressed and the housing upper section opened. In this version the pressure piston has a stepped constriction 57 and the freedom of movement of the arrester bolt 55 is blocked by the thicker region. In other versions the pressure piston 6 can have a constant diameter and the arrester bolt 55 is released only when the pressure piston is held by the tensioned compression spring 16 underneath the arrester bolt.

List of r ference numb rs

1 Device for the exertion of pressure optionally with container
2 Unit comprising housing upper section and housing middle section
2a Housing upper section
2b Housing middle section with locking clamping means
3 Housing lower section
4 Opening
5 Axis of symmetry
6 Pressure piston
7 Protective cap
8a Locking mechanism
8b Locking mechanism
9 Outlet for liquid
10 Container cartridge
11 Groove
12 Holding means
13 Movable button
14 Transport carriage
15 Clamping element / Drive flange
16 Compression spring
17 Mouthpiece
18 Grip
19 Hinge cf. 48
20 Detent
21 Swivelling flap
22 Release button
23 Movement mechanism
24 Tongue-shaped section of the protective cap
25 Tongue-shaped recess of the housing
26 Housing
27 Hinged arm
28 Mechanical drive unit
29 Atomization facility
30 Accommodation chamber
31 Compression spring housing
32 Snap catch
33 Drive flange
34 Locking member
35 Release key cf. 46
36 Lower stop
37 Upper stop
38 Guide cylinder
39 Container piston
40 Stock cylinder
41 Nozzle structure
42 Base part
43 Non-etched part of the base part
44 Nozzle opening
45 Filter-forming projections
46 Nozzle inlet side
47 Closure key cf. 54
48 Hinge cf. 19
49 Arrester bolt
50 Locking bolt
51 Spring
52 Recess
53 Thick region of the locking bolt
54 Closure key cf. 47
55 Arrester bolt

56 Spring
57 Constriction
58 Upper sealing means
59 Lower sealing means
60 Holder
61 Crimping sleeve
62 Screw cap
63 Baseplate
64 Closure between housing lower section and compression spring housing

Patent claims

1. Device for the delivery of a predosed quantity of a drug in dissolved or suspended form as a liquid jet or an aerosol of droplets by delivery of the predosed quantity under pressure by a dispensing facility (29), comprising

- an elastic element (15, 16) for the storage of a predetermined quantity of energy

- a mobile element (6) to which the predetermined quantity of energy can be fed and which can expose the dosed fluid quantity to a predetermined increase in pressure,

characterized in that

- means (4, 12, 13, 14, 18, 19, 21, 22, 23, 27) for the respective introduction and removal of a container cartridge (10) containing the drug into and from an accommodation chamber (30) lying in the inside of the device and

- means for the feeding of the pressurized drug to a dispensing facility (29) firmly connected to the container cartridge (10) are provided.

2. Device according to claim 1, characterized in that the container cartridge (10) can be introduced into the accommodation chamber (30) via an opening (4) in the housing wall (26) of the device.

3. Device according to claim 1 or 2, characterized in that the container cartridge (10) can be introduced directly into its end-position in the device.

4. Device according to claim 1 or 2, characterized in that the container cartridge (10), after its introduction into the housing opening (4), can be transferred into its end-position by a transport means, in particular a transport carriage (14).

5. Device according to one of claims 1 to 4, characterized in that a part of the housing wall is a constituent of a removable grip (18) which is provided with a holding means (12) for accommodating a container cartridge (10).

6. Device according to one of claims 1 to 5, characterized in that the device has a housing lower section (3), one end of which defines the bottom-side end of the device, a housing middle section (2b) housed rotatable against the housing lower section (3) and a housing upper section (2a), designed vertically swivellable or eccentrically rotatable relative to the housing middle section (2b), with the means (30) for accommodating the container cartridge (10), wherein the end which, in the closed state of the device, is not connected to the housing middle section defines the top-side end of the device.

7. Device according to claim 6, characterized in that the container cartridge (10) can be introduced into a bore (30) passing through the housing upper section (2a).

8. Device according to claim 7, characterized in that there are developed on the bore (30) one stop or more stops beyond which the container cannot be pushed and/or means are developed for guiding the container cartridge (10) optionally up to the stop or stops.

9. Device according to one of the preceding sections 1 to 8, characterized in that the elastic element for the storage of a predetermined quantity of energy is a spiral spring (16) which is part of a locking clamping means and via which a drive flange (33), which is connected to a pressure piston (6), is moved vertically.

10. Device according to claim 9, characterized in that the compression spring (16) is located in a compression spring housing (31) which is housed rotatable in the housing middle section and is connected to the housing lower section, the compression spring (16) being tensioned via a gear system when the housing lower section (3) and/or the compression spring housing (31) is rotated against the housing middle section (2b) and moves the drive flange bottom-side and the compression

spring remains in the tensioned position via a locking member (34), until a relaxation occurs due to the pressing of the release key (35) connected to the locking member (34).

11. Device according to one of the preceding claims 6 to 10, characterized in that blocking means are developed for blocking the release key (35) that are coupled to the closure mechanism between the housing upper section and housing lower section.

12. Device according to claim 11 in combination with one of claims 6 to 10, characterized in that the blocking means comprise a mobile locking bolt (50) which prevents the horizontal release movement of the locking member (34) and/or of the release key (35).

13. Device according to one of claims 1 to 12, characterized in that the device has closure arrest means (54, 55, 56) which prevent the housing upper section (2a) from being opened as long as the compression spring (16) is not tensioned, and the pressure piston (6) thus projects into the housing upper section (2a).

14. Device according to claim 13 in combination with one of claims 6 to 12, characterized in that the closure arrest means comprise a mobile arrester bolt (56) which prevents the release of the closure key 54 until the pressure piston (6) is in the position defined by the tensioned spring (16).

15. Dimensionally stable, manually not deformable container cartridge (10) with a base part and a top part, the top part being formed by a dispensing facility (29) from which a stock cylinder (40) for accommodating a drug in dissolved or suspended form leads to the bottom of the container cartridge, which is closed by sealing means (59) not indestructibly removable from the container cartridge and/or a container punch (39) movable into the stock cylinder (40), sealing and not projecting outwards beyond the bottom area of the container cartridge, and/or by a rigid baseplate (63).

16. Container cartridge according to claim 15, characterized in that the dispensing facility (29) is closed to the outside by a sealing means (58).

17. Container cartridge according to claim 15 or 16, characterized in that the dispensing facility (29) is held in the top-side opening of the stock cylinder (40) by at least one holder (60).

18. Container cartridge according to one of claims 15 to 17, characterized in that the dispensing facility (29) and/or the holder (60) is (are) held in the top-side opening of the stock cylinder (40) by gluing, welding, ultra[sonic] welding, crimping and/or a screw cap.

19. Container cartridge according to one of claims 15 to 18, characterized in that the container punch (39) is a piston (container piston) or preferably a ball (container ball).

20. Container cartridge according to one of claims 15 to 19, characterized in that the stock cylinder has a filling capacity of at most 100 µl.

21. Container cartridge according to one of claims 15 to 20, characterized in that the stock cylinder has a filling capacity of at most 15 µl.

22. Container cartridge according to one of claims 15 to 21, characterized in that the dispensing facility (29) is a nozzle with an opening.

23. Container cartridge according to one of claims 15 to 21, characterized in that the dispensing facility (29) is a nozzle with at least two openings.

24. Container cartridge according to claim 23, characterized in that the channels leading to the at least two openings are oriented to each other in the direction of the openings, so that liquid jets or aerosol clouds dispensed from the openings collide with each other.

25. Container cartridge according to one of claims 15 to 24, characterized in that the dispensing facility (29) has filter means (45).

26. Container cartridge according to one of claims 15 to 25, characterized in that the dispensing facility (29) consists of at least two parts, each with at least an essentially flat surface, via which the two parts are connected to each other to form a unit, at least one of the surfaces having a microstructure with channels which form at least one liquid inlet into the unit and at least one liquid outlet from the unit, optionally filter means and/or one or more plenum chambers.

27. Container cartridge according to one of claims 15 to 26, characterized in that the container cartridge is not plastically deformable up to a pressure difference between the inside of the stock cylinder and the external surroundings of at least 49 bar.

28. System for the delivery of a predosed quantity of a medico-therapeutically and/or medico-prophylactically effective substance in dissolved or suspended form as a liquid jet or an aerosol of droplets by delivery of the predosed quantity of the drug under pressure by a dispensing facility (29), comprising a device according to one of claims 1 to 14 as well as at least one container cartridge according to one of claims 15 to 27.

29. System according to claim 28, characterized in that it is a needleless injector.

30. System according to claim 28, characterized in that it is an inhalation device.

31. System according to claim 28, characterized in that it is an atomizer for the application of a spray to the surface of the eye.

Abstract

The present invention relates to a propellant-gas-free apparatus for the dispensing of liquids, a container cartridge suitable for this for storing the liquid and the ensemble comprising both. The invention comprises a device for the exertion of pressure and for accommodating a container cartridge and a container cartridge in which the dispensing facility is integrated.

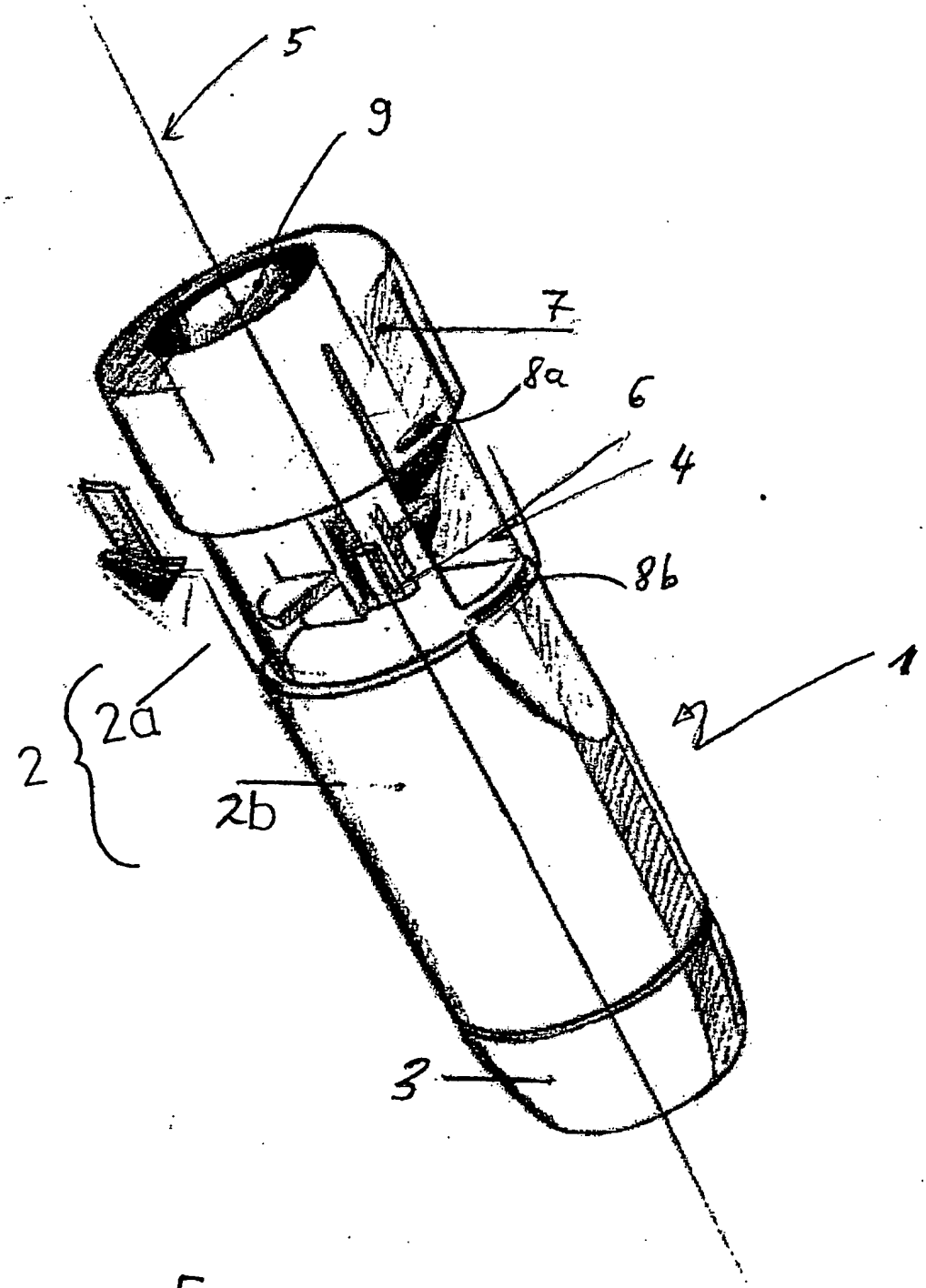


Fig. 1

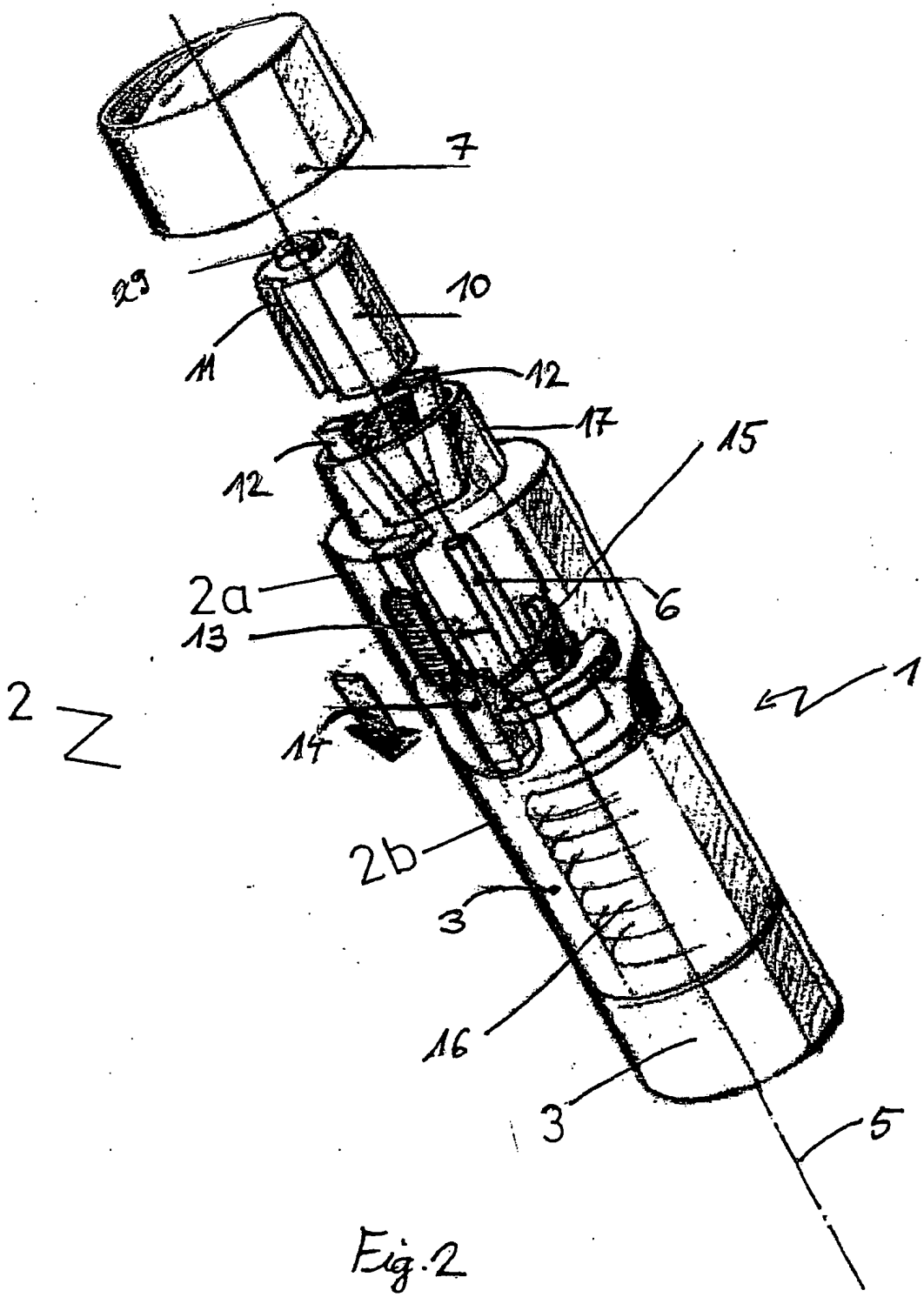


Fig. 2

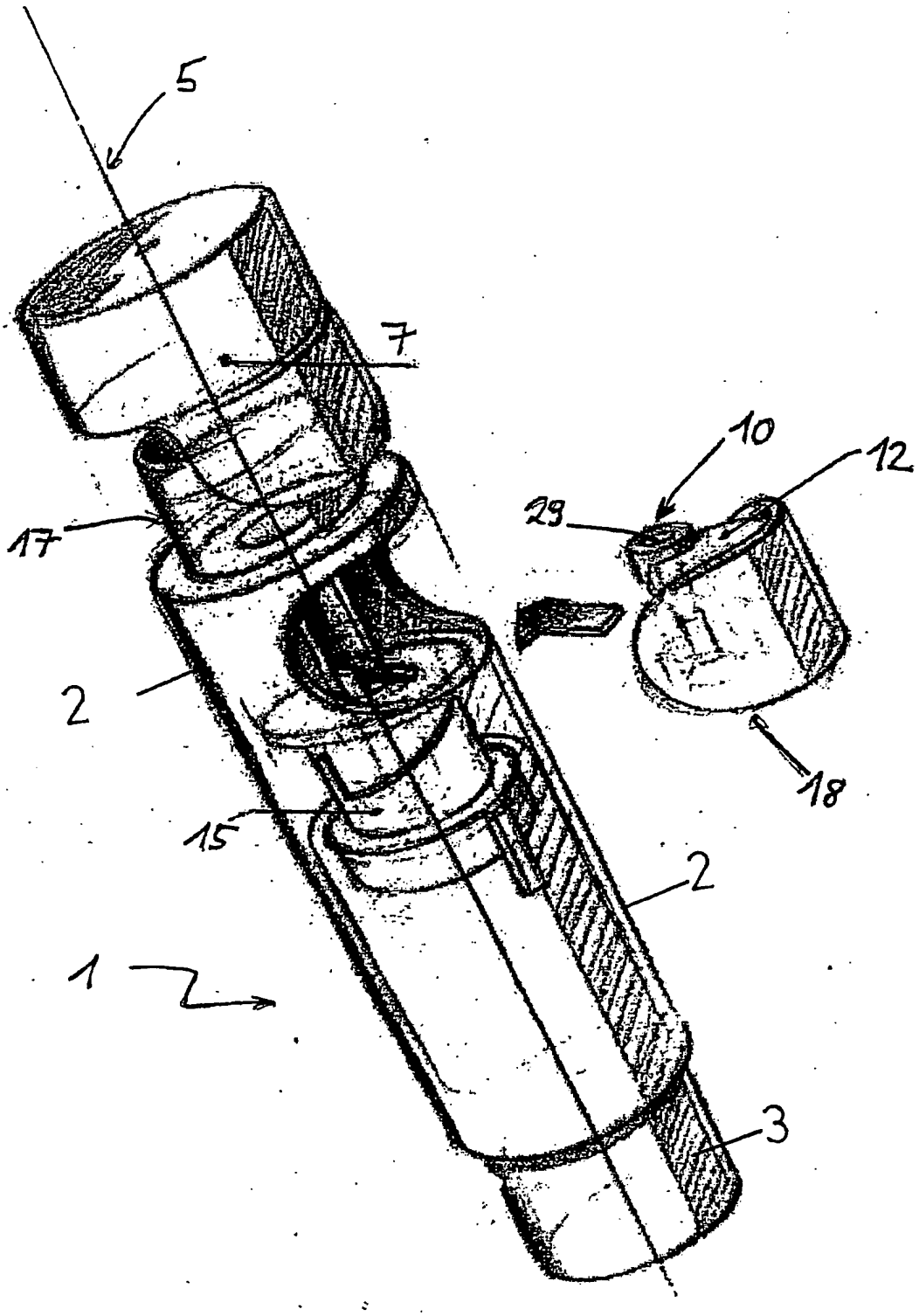


Fig. 3

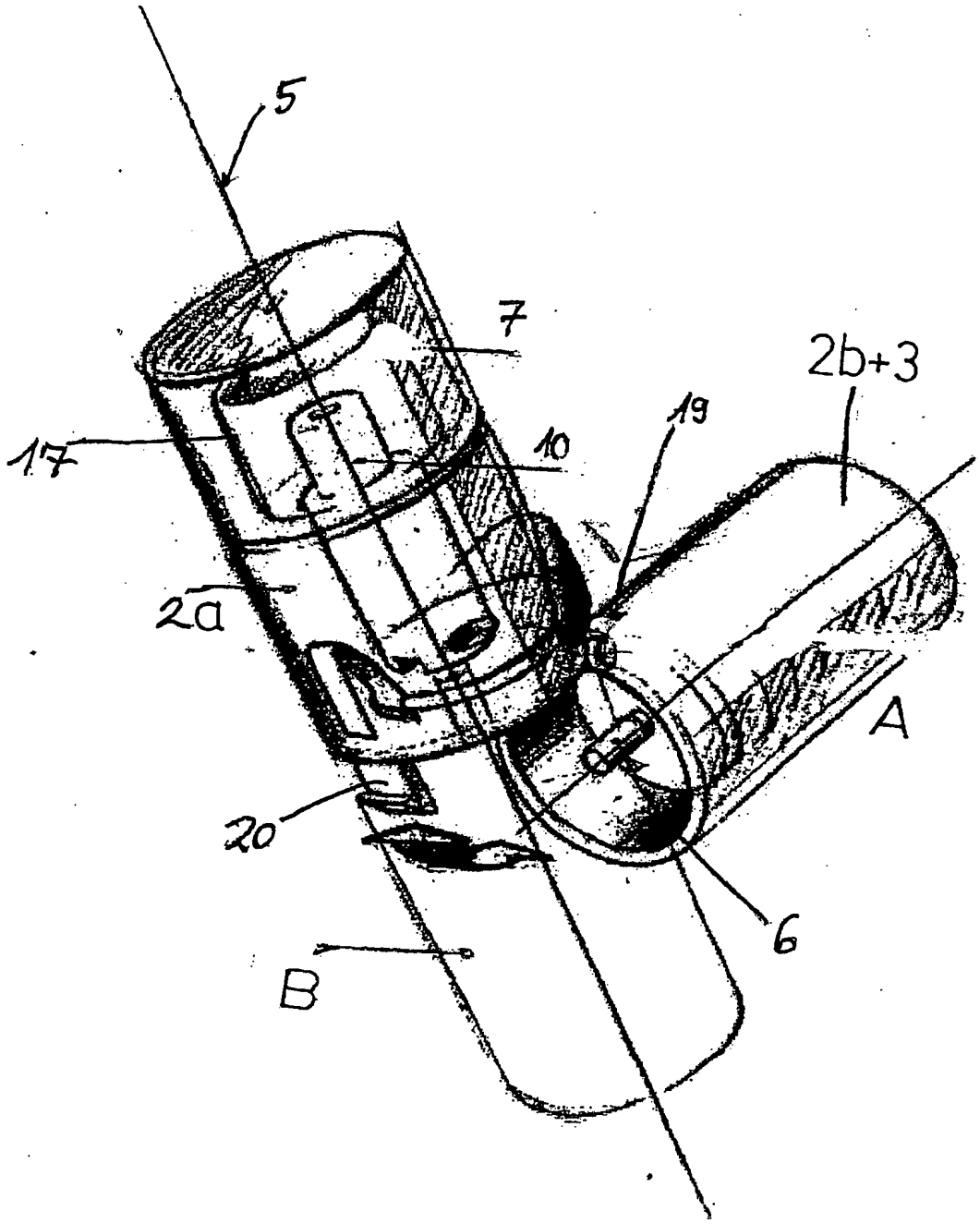


Fig. 4

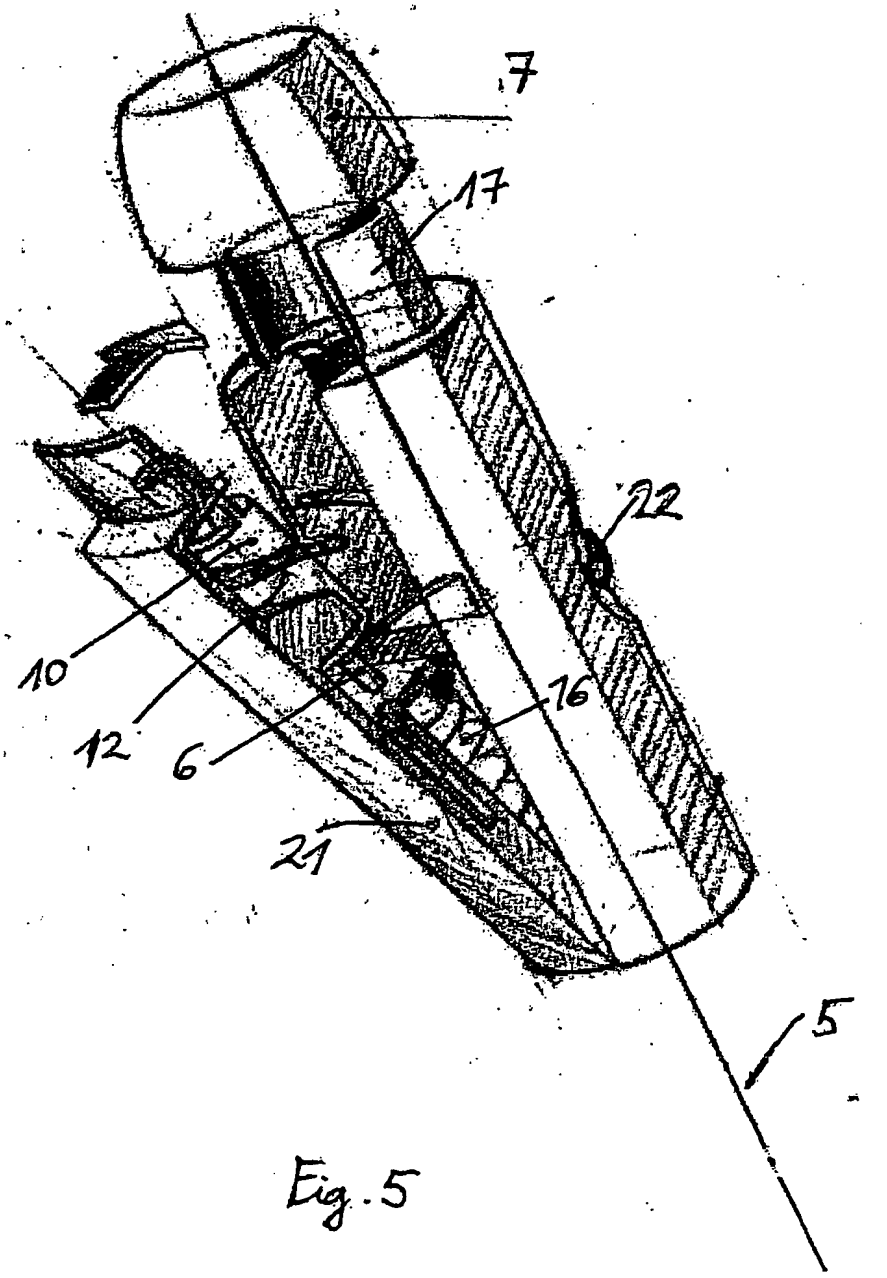


Fig. 5

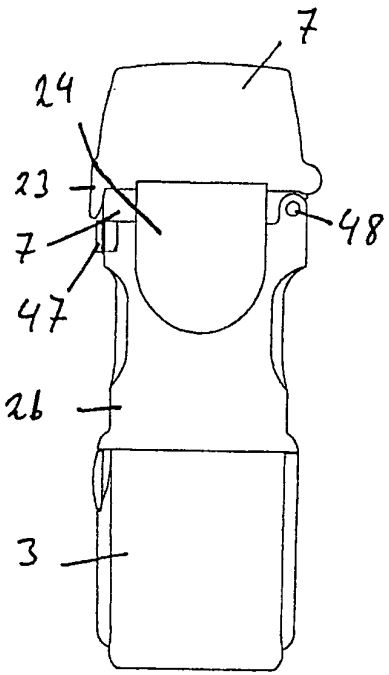


Fig. 6a

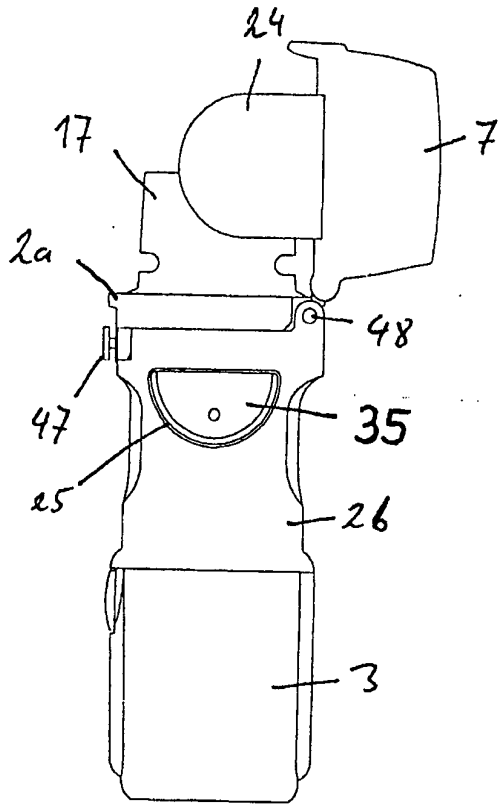


Fig. 6b

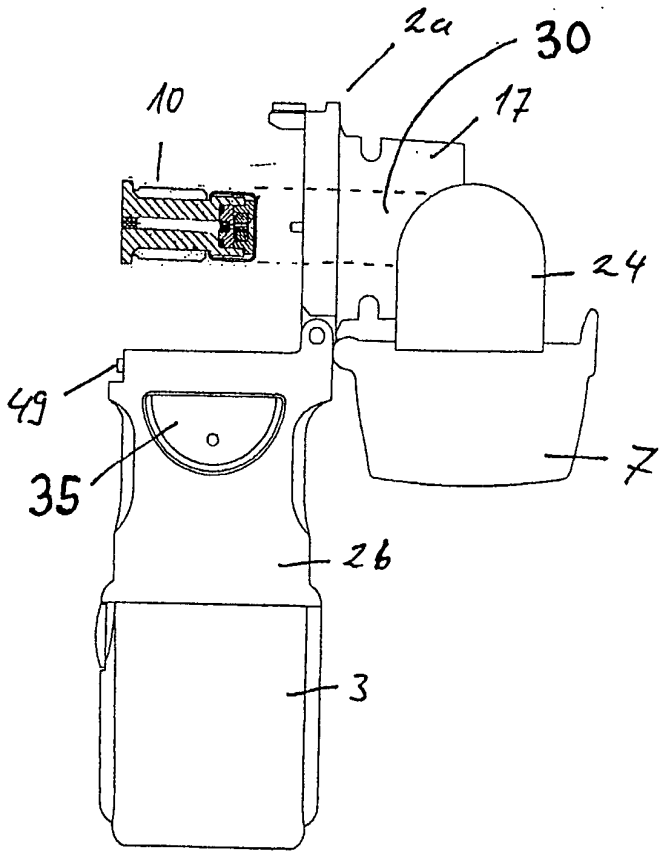


Fig. 7

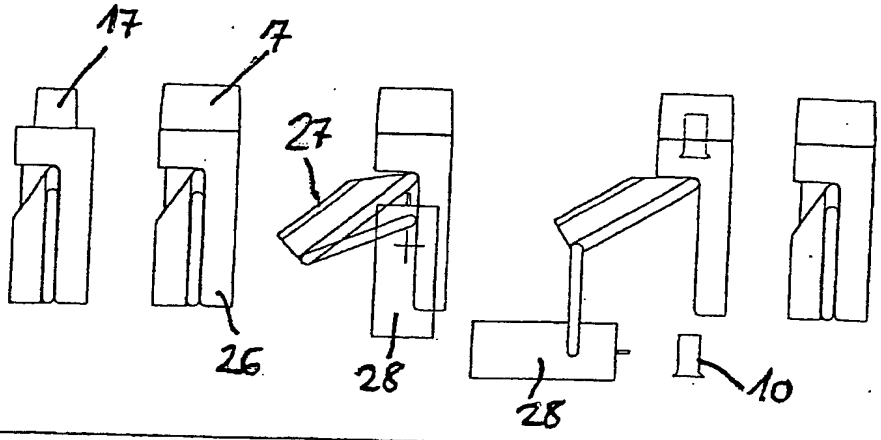


Fig 8

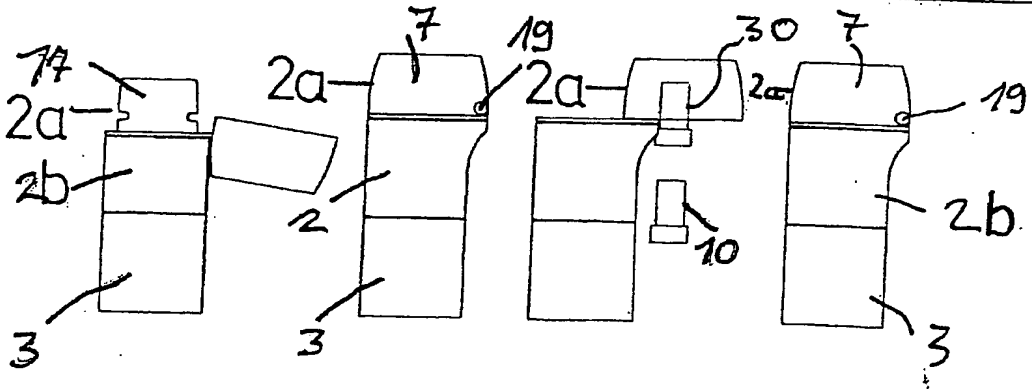


Fig 9a

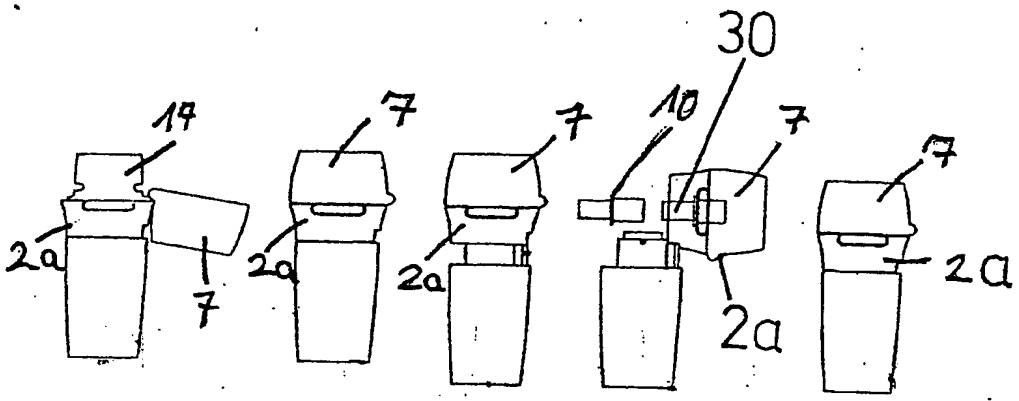


Fig. 96

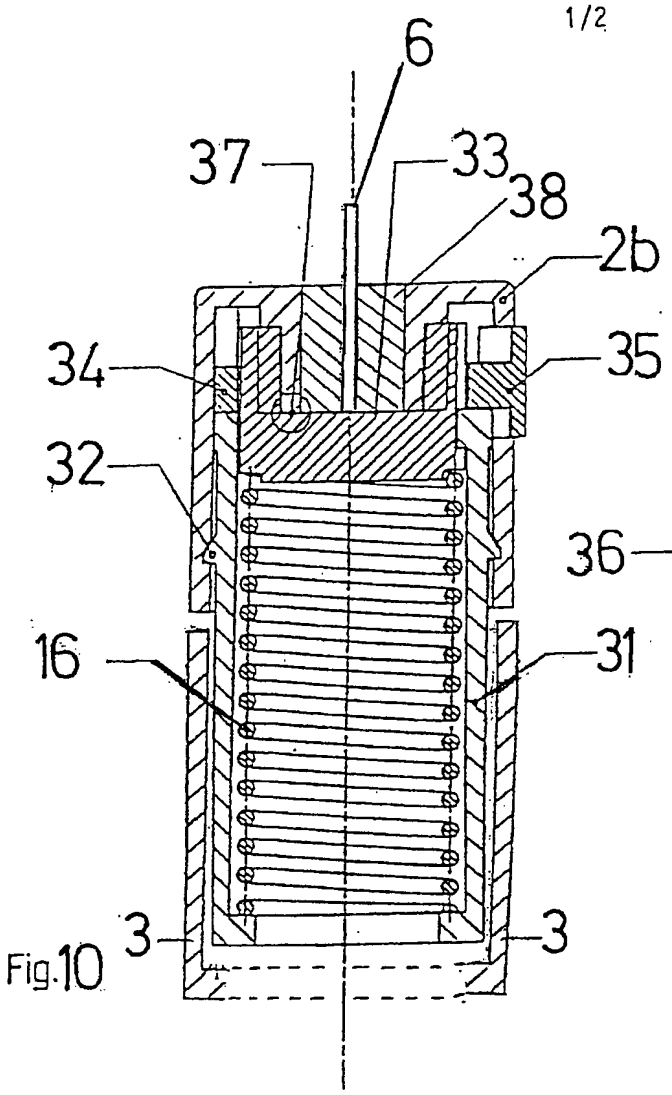


Fig.10

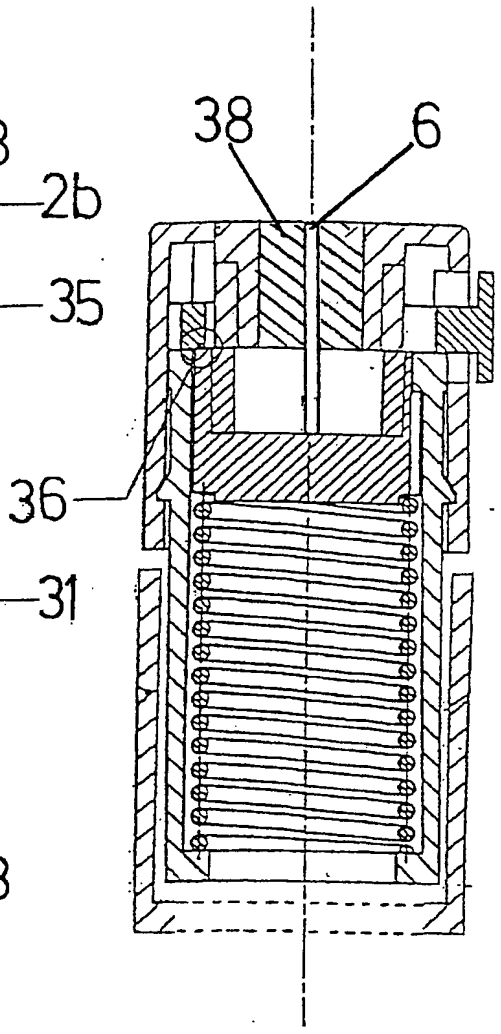


Fig.11

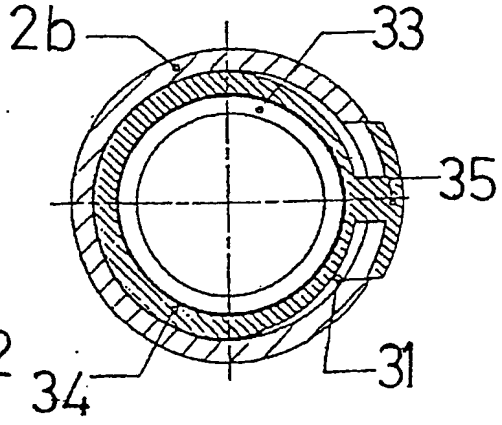


Fig. 12

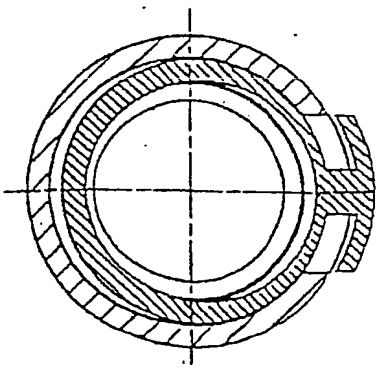


Fig. 13

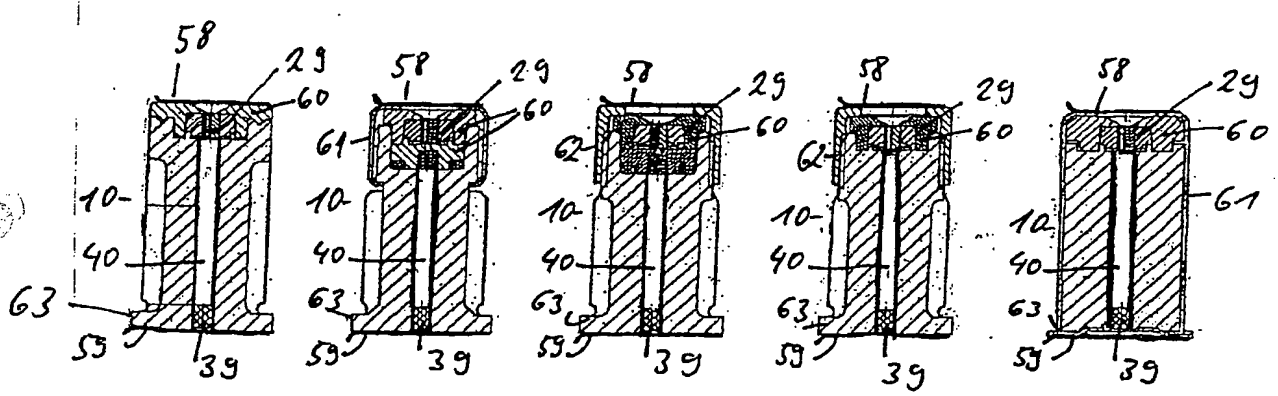


Fig. 14a Fig. 14b Fig. 14c Fig. 14d Fig. 14e

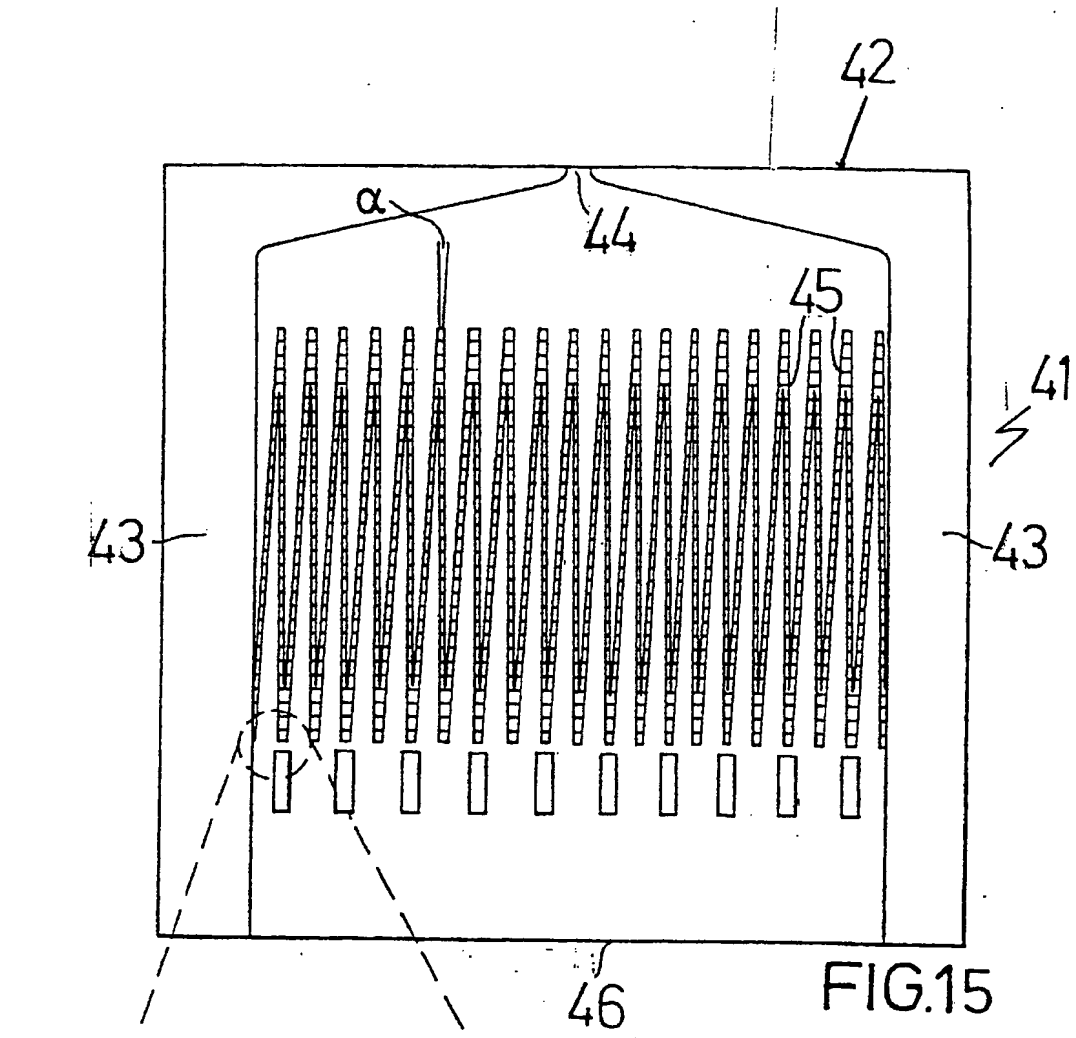
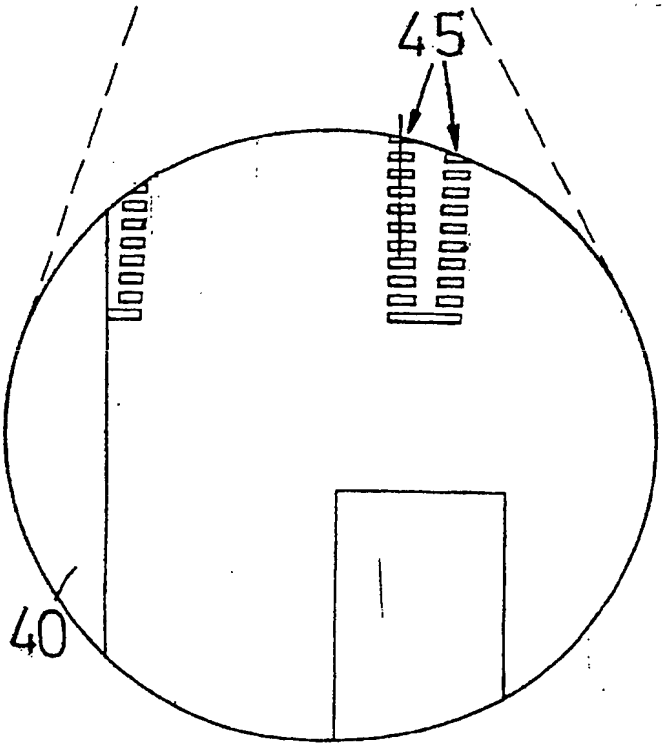


FIG.15



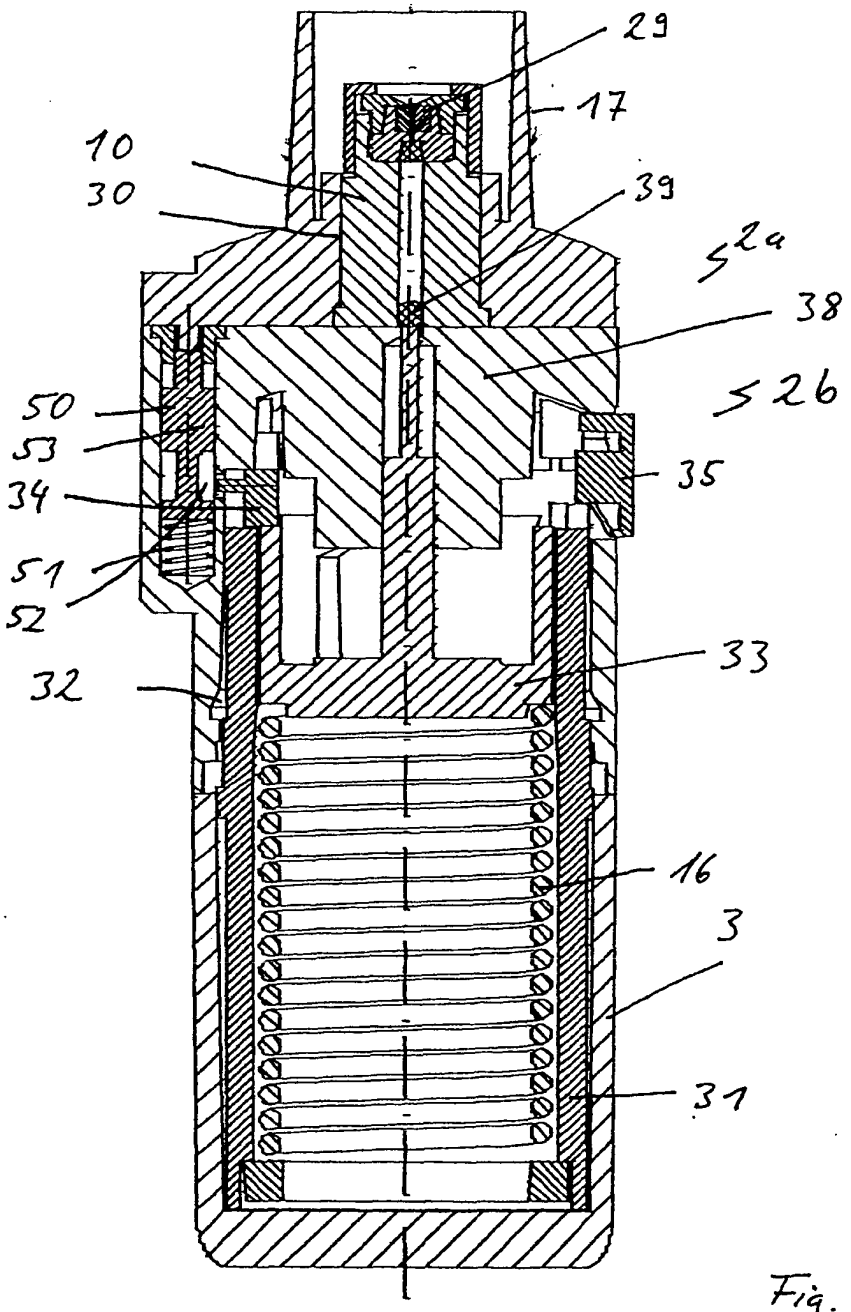


Fig. 16

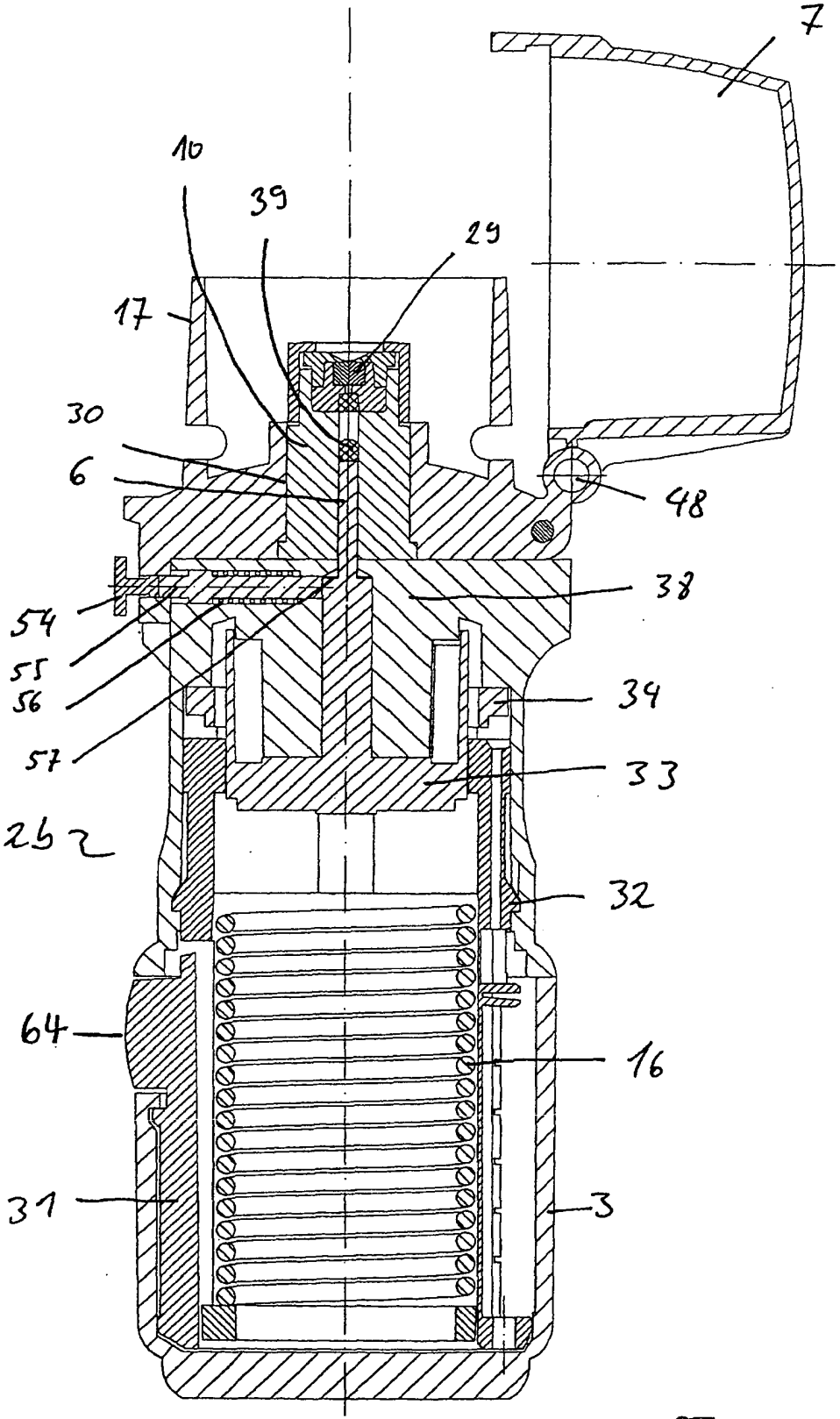


Fig. 17